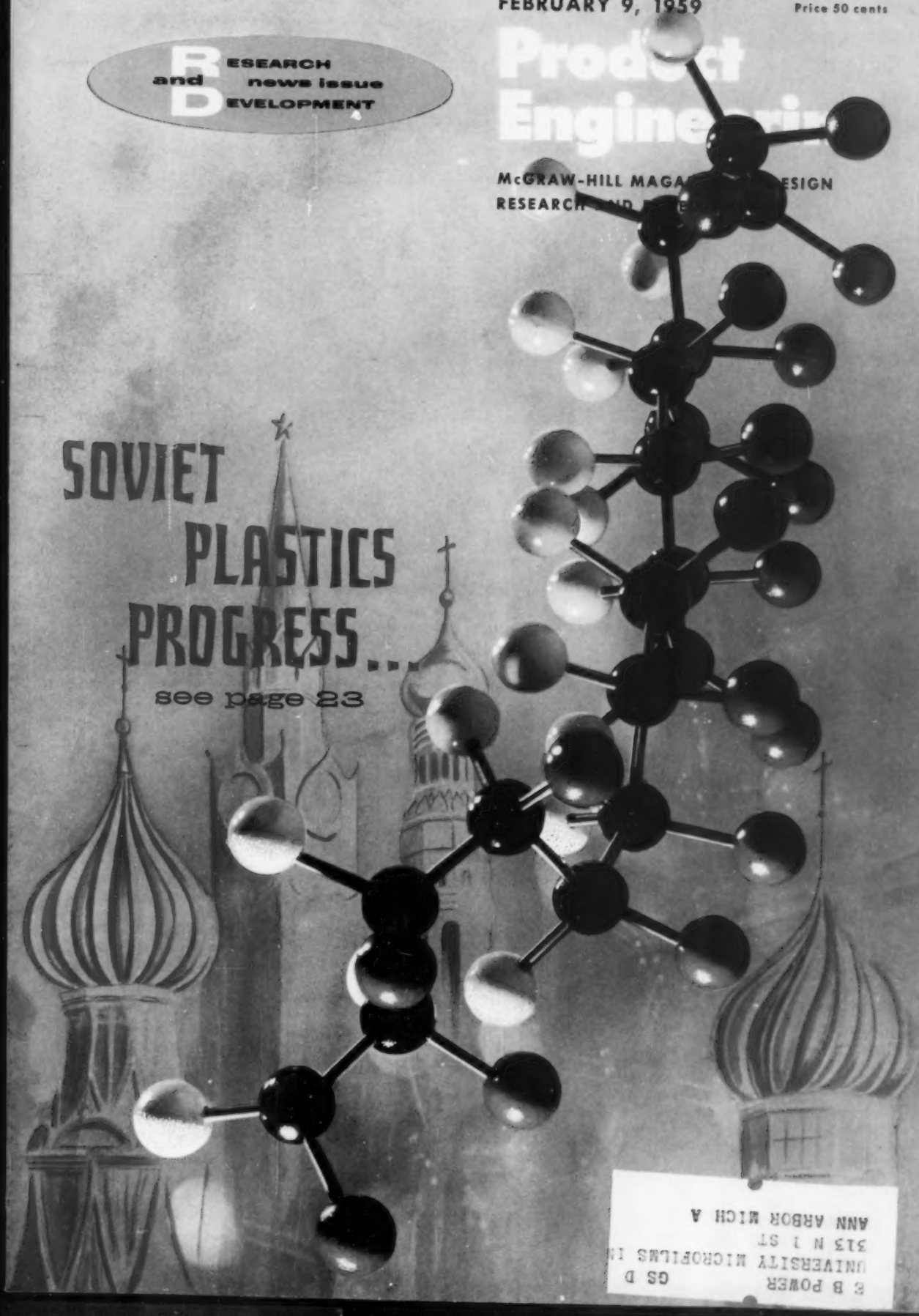
FEBRUARY 9, 1959 Price 50 cents

R&D RESEARCH and DEVELOPMENT news issue

Product Engineering

McGRAW-HILL MAGA... ESIGN
RESEARCH ...



SOVIET PLASTICS PROGRESS...

see page 23

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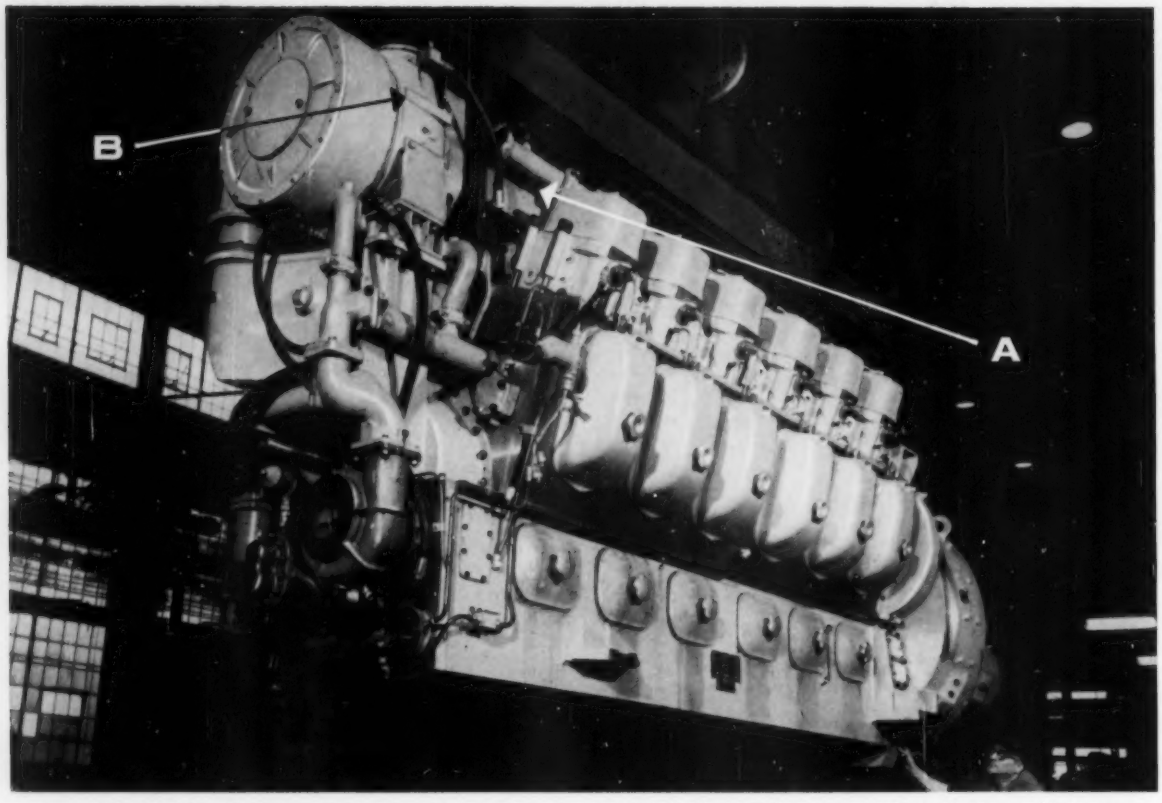

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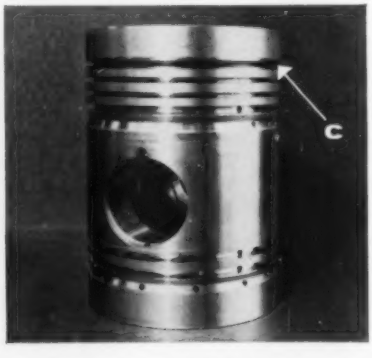

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- **What's new about the new papers?**
  They're engineered to be strong, stable, moisture resistant, stretchable, heat and flame resistant.

- **Failure diagram for safe stress limits**
  How to determine safety factors when fluctuating loads are superimposed on existing stresses.

- **Forging presses strength into lightweight castings**
  How follow-up forging can improve parts cast from aluminum and magnesium alloys.

- **Design guide to an air-cooled product**
  Will your product run too hot? Here's how to find out whether self-cooling methods will work.

- **Universal tables for circular segments and sectors**
  Here's a quick way to find all the dimensions you want.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

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● **During his trip to USSR** (p 23) J. E. FitzGerald took hundreds of pictures. Here are two taken in Russian parks. The first shows a trimmed hedge in the form of stalking lions – imaginative and humorous. The second is of one of dozens of signs, tucked among lovely park trees, listing US production in 1956 versus USSR production in 1957 and at the end of the next 7-year plan. Driving competition in steel, coal, sugar, shoes–even on a lovely afternoon's stroll.

● **The Quaker Oats Co** has temporarily shifted its contests off the cereal boxtops and into the chemical press. Have you seen the publicity about its Big Idea Contest? $10,000 in cash prizes, nine rules in small type and a coupon that begins, "My Big Idea for QO Levulinic Acid ($CH_3COCH_2CH_2COOH$) is . . ."

● **In the early days of the automobile,** says Robert H. Maguire, chief stylist of Ford's interior studio styling office, ". . . little thought was given to styling . . . we were then enchanted with the mechanics of things and car buyers were interested principally in whether a car would run. Next came the production phase. And this, like the engineering phase, illustrated the dominance of the male in making purchasing decisions. Father wanted to know how well a car was built and how long it would last. Now, though, the engineer and the production man have done their work so well that the public generally takes for granted the fact that an automobile is structurally sound. Now the average car buyer seeks the product that is most pleasing to the eye . . . it has become even more important that it present an exciting and attractive appearance." It seems father is in the back seat and his letters (p 6) have a faintly plaintive sound.

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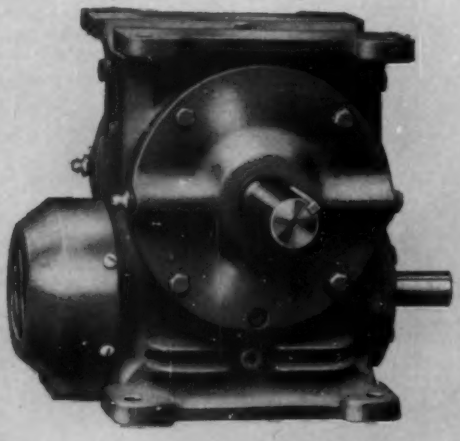

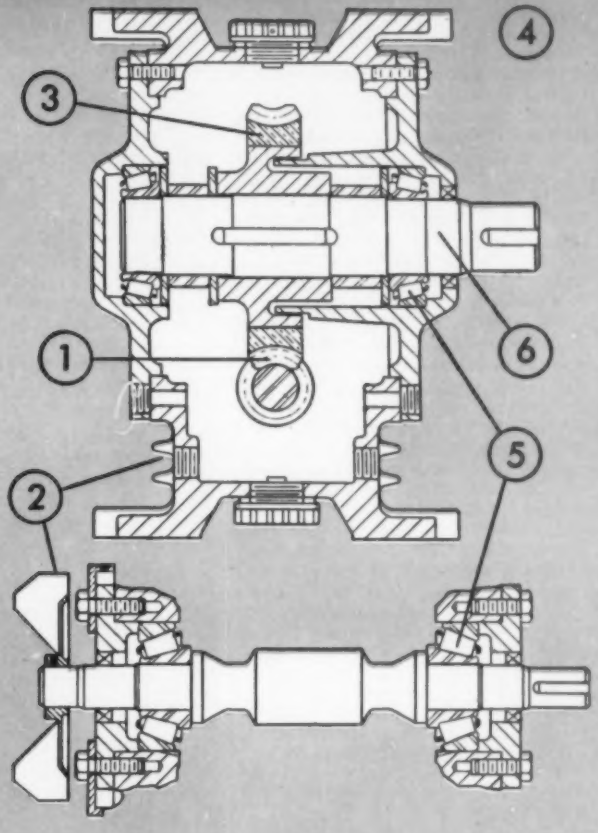

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Reader To Editor...

More Car Comments

Since our publication of the article, "Eight Design Authorities Evaluate '59 Cars," (Dec 1, p 26) we've been swamped with readers' comments. We published some on Jan 12, p 6; here are more—

To the Editor:

Design engineers, no matter what field they work in, should always try hard to develop the most efficient, sturdy and foolproof equipment possible. But what is the trend in our car-making industry? The thermal efficiency of engines has not improved. The life of an engine has not been prolonged at all. The mechanical efficiency of the transmission has dropped sharply from the 97% mark of prewar times. Mileage per gallon of gas has been on a downtrend for some time.

The times are definitely gone when the car owner could fix small difficulties himself. I think that Detroit's car designers might look around a little at what their European colleagues are doing, and readjust themselves a bit. To read MTZ and ATZ periodicals, besides *Automotive Industries*, should be a must for every well-informed automotive engineer. I also strongly recommend that body designers read carefully the book on *Streamlining of Vehicles* (*Aerodynamik der Kraftfahrzeuges*, written and published by Von Freiherr Koenig-Fachsenfeld in 1951), and make good use of what they learn.

—Otto V Drtina
Cleveland

To the Editor:

. . . After looking over the ugly new monsters, my wife and I decided on a 1953 Studebaker 5-passenger coupe. . . .

—J Andresen
Greenwood Lake, N Y

To the Editor:

One of your correspondents writes in the Jan 12, issue, "By golly, I am for length, absurd fishtails, and loads of chrome because it reflects my personality and advertises that I am a success."

Actually, all of the ostentatious and useless "gee haws and doodads" are used, in many instances, to hide an inferiority complex and attempt to give an impression of success that really isn't too successful in the final analysis. Nevertheless, let's continue to buy our American-made vehicles, as apparently they are the red corpuscles in the bloodstream of our economy.

—M W Hill
Portland, Conn

To the Editor:

As a design engineer, I am cognizant of the desirability to achieve beauty with lines and forms. There is something even more important, however, and that is to have "Honest Design." Honest design treats only the essential forms; it does not add forms or "globs" just for the sake of having something to "sculpture."

Fenders on automobiles are essential forms, fins on aircraft are essential forms; however, fins on automobiles are neither essential nor helpful and are therefore dishonest.

I think the current automobile design trends indicate a moral decay in America that is most alarming. When such a large slice of national income is squandered on useless glass, fins, overhang, etc., which requires excess horsepower and the attendant wasted fuels, then it's about time the Federal government stepped in and placed a tax on automobile body weight and horsepower. This is most undesirable, but it will be necessary unless the automotive industry reexamines the function and purpose of the automobile and designs it accordingly. They must also remember that economy as well as function is most to be desired. If an automobile requires over 100 hp, it is too damn big and wasteful.—L. L. Chambers
Sunland, Calif

To the Editor:

. . . Decorations on top of front fenders and hood, just as well as fins, I consider dangerous. All outside corners of the body should have radii of at least a couple of inches. . . .

—P. C. Brunting
Plainfield, N J

To the Editor:

. . . I would much rather offer constructive suggestions on the mechanics of a car than on the appearance. I feel that the mechanics, too, leaves something to be desired. . . .

—H K Bradford
Fairfax, Va

To the Editor:

The dedication of Detroit's designers to masses of chrome and to false impressions of great weight and mass represents a form of autointoxication with idols of clay which should never be praised by any person dedicated to a healthy combination of beauty, safety and utility.

Since your article dealt with the question of styling rather than over-all design, I shall restrain myself, albeit with some difficulty, from vigorous condemnation of the worship of horsepower for horsepower's sake. The best analogy I can think of is based on the assumption that because Primo Carnera, ex-prize fighter, was the biggest and strongest man in the ring he was therefore also the best—a fallacy which Mr. Carnera's fans discovered the hard way.

—R E Kaufmann
Saratoga, Calif

To the Editor:

. . . . Try and get in and out of any 1959 GM cars' rear seats. It's hard to crawl in—almost impossible to get out. . . .

Bill Davidson
Kansas City, Mo

To the Editor:

. . . . To the comments offered by your guest critics I would say—Amen. Our family is in need of a new car and as much as I should like to buy an American car to help our own economy I am afraid the choice is Volkswagen.—E. A. Martinez
Denver, Col

To the Editor:

After reading your article by the eight design authorities, I would like to know what kind of transportation is used by Messrs. Sundberg and Ferar, goat or jeep?

—J. B. Smith
Tuscaloosa, Ala

To the Editor:

Detroit has gone design-happy with little or no concern for basic engineering and economics. Of all the '59s, Cadillac is the worst. Chevy's rear-end treatment is atrocious, Chrysler's "swept wing theme" is asinine, and even Ford (to which I am partial) missed the boat with dinner-plate-size taillights. My next car will be a small, economical foreign car.

—Donald P Cooley
San Francisco, Calif

To the Editor:

I cannot help feeling that the American car can no longer be regarded as a means of transportation. Rather, it has degenerated into an expression of social prestige. The whole Detroit concept of planned obsolescence sees to it that the gleaming monster that is the neighborhood eye-opener this year will be old-fashioned next year. How so much "style" and yet so little function and quality can be rolled into one package is almost inconceivable. I have long admired the imports for their clean, honest approach to motoring. Here is the only automobile market where one can buy real quality, as well as a guarantee against obsolescence.

—Greer Hill
Berwyn, Penna

To the Editor:

It is easy to criticize any new product. Many of the "experts'" opinions are well taken; others are so far from practical as to draw heavy comment from automobile people who do know what constructions can and cannot be made economically within tooling budget limits. With the exception of Raymond Loewy, however, who has made some sketches, the group have simply made heavy critical comment without supplying any solutions as a constructive suggestion. As a major point of general interest we believe you should give consideration to providing another article wherein these same "experts" provide sketches of their own suggested solutions in changing design of the make of car they became critical of, purely as a true constructive measure. The automotive people are entitled to this comment as to how they might improve their products. Destructive criticism has no place today among fair-minded readers.

—George H. Kendall
Darien, Conn

• All auto companies as well as the Automotive Manufacturers Assoc were sent advance copies of the article. We received no replies.—Ed.

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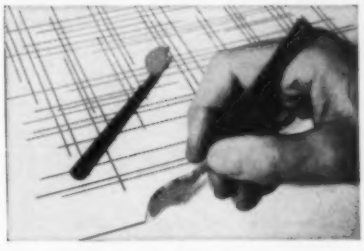

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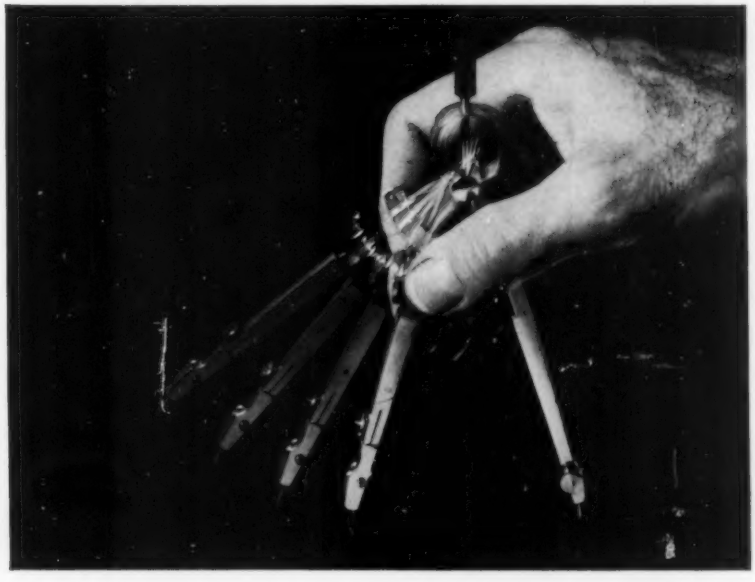

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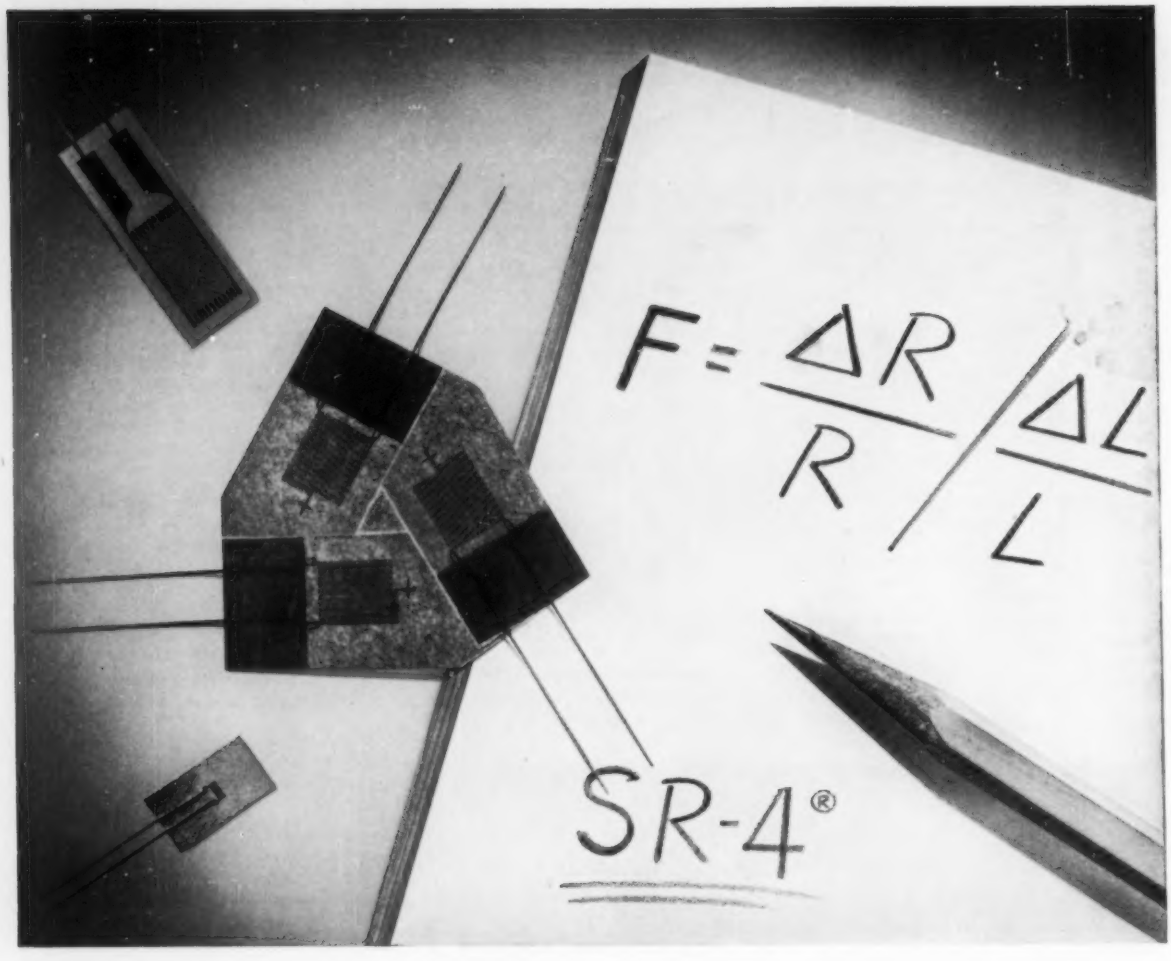

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DEVELOPMENTS TO WATCH...

A

Stronger, harder alloys may be developed . . .

. . . say General Electric metallurgists, as a result of new measurements of critical size and distribution of the submicroscopic particles responsible for such effects as precipitation-hardening in metals.

Using copper-cobalt alloys as "guinea pigs," and magnetic methods for studying them, GE researchers have found that "there exists a critical size of particle for which the hardening of an alloy is at a maximum." Furthermore, for the specific group of alloys studied, nearly all of the cobalt present is precipitated in the first few minutes of aging (at 1100 F) and that, thereafter, increasing tensile yield stress is a matter of increasing particle size and distribution until an optimum particle size (in this case, 70A) is reached.

A report on the study, with a bibliography on earlier work, has been prepared by J. D. Livingston of the GE Research Lab, and may be had on request.

Thermoelectric generators that use radioisotopes . . .

. . . as heat sources (*PE—Apr 21 '58, p 16*) are now to be made commercially by Minnesota Mining & Mfg Co. First available is an air-cooled unit. In the 5-watt size, it will be about 3 in. dia; 6 in. high; will operate at efficiency of about 6%. Water-cooled units are now being designed; and 3-M expects eventually to have a full range of these devices—ranging in size from ½ watt to, perhaps, several thousand. (Note: For more on thermoelectric devices, see p 14 and next issue.)

Improved fungicides make it possible to design paper . . .

. . . into many new applications like the paper sandbags now being developed for military use.

Scientific Oil Compounding Co, Chicago 23, reports, for example, that papermakers are now able to produce moldproof kraft paper sheets which "have surprising durability." Here, the basic treatment compound is copper-8-quinolinolate, developed during World War II, but now in new formulations.

Also under development are volatile fungicides, much like the volatile corrosion inhibitors and the vaporizing germicides (*PE—May 19 '58 p 5*), which provide continuing protection for products and materials and are said to prevent "jumping" of fungus growth from one area of a product to another.

(Note: See next week's issue for staff report on paper and its use in mechanical products.)

An abrasive finishing machine that reverses the usual method . . .

. . . of handling machined parts has been designed at Abrado Finish Corp, Grand Rapids, Mich. Instead of feeding the abrasive slurry over the part, this machine lowers the parts into a rotating tub of slurry (see photographs), brings them out when the desired finish has been achieved. Abrado says the new system is faster, easier, lends itself to precise control. —ARG

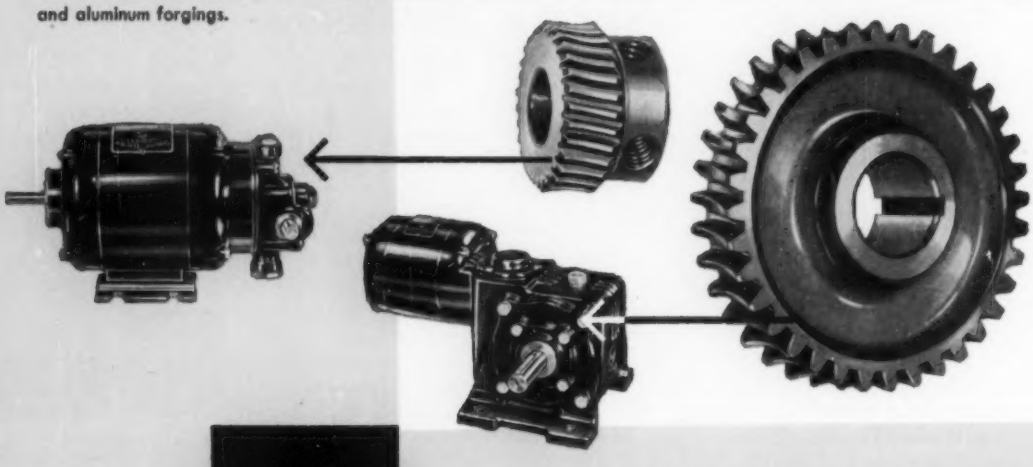
Speed of operation is one of several advantages claimed for new Abrado-Matic finishing system. Photo at left shows machine with head erect so parts to be finished can be attached to spindles. At right, the unit goes to work.

MUELLER BRASS CO. forged gears improve dependability and performance of BODINE electric motors

For combined high shear strength and maximum wear life in their single and double reduction speed reducer motors, Bodine Electric Company of Chicago uses gears forged from Mueller Brass Co. 603 Alloy.

Bodine has specified Mueller Brass Co. forged gear blanks because of their consistently high quality . . . there is no porosity, foreign inclusions or defects typical of cast blanks. The hot working of the metal followed by heat treatment to the desired physical properties produces a refined grain structure to give uniform machining and wear in service. The forged blanks are consistent in size and held to close tolerances. Bodine has also found that the excellent machinability of the blanks in the hobbing operation increases overall hob life.

For forgings of high tensile strength, high density, minimum porosity, light weight, corresion resistance, good machinability and low costs with little scrap loss, it pays to specify forgings from the Mueller Brass Co., the world's largest producer of brass, bronze and aluminum forgings.



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can offer unbiased advice on the "one best way" of producing your parts, because Mueller Brass Co. is the only fabricator in the country offering all these methods of production . . . assuring you the best product at the best price . . . made the one best way.

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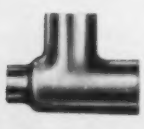
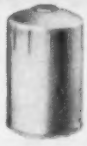


FORMED COPPER TUBE

PLASTICS INJECTION MOLDING



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DEVELOPMENTS TO WATCH...

world-wide

Ac voltmeter, aimed at applications that require . . .

. . . steady rms voltage-value readings on very low frequency 3-phase ac supplies, is announced by Crompton Parkinson Ltd of Aldwych, London, Eng. Immediate application is expected in the nuclear field, where, for instance, there are reactor control-rod systems operated by very low speed motors using currents with frequencies that vary from zero to no more than 2 cps.

At these low frequencies, CP engineers explain, the instantaneous value of voltage varies so slowly that the pointer of an ordinary instrument has time to follow it instead of indicating a steady rms value.

To get around this problem, CP designed what is basically a dc moving-coil voltmeter, operated from a phase-splitting network with full-wave rectification. The network produces 12 impulses per cycle across the coil, thus reducing the magnitude of the applied ripple voltage and increasing its frequency. "Tests have shown," the company says, "that the pointer deviation on either side of the mean amounts to no more than 0.3% at 2 cps"; and the instrument can be used to indicate the rms value of an applied 3-phase voltage at any frequency from 0 to 2500 cps. Both switchboard and portable models are to be made.

Gas turbine power is replacing conventional turbo-drills . . .

. . . in Soviet oil fields. A new lightweight (70-ton) gas turbine makes the change possible, the Soviets say. It delivers 3000 hp, permits a drilling speed "3 to 5 times the former level," yet weighs less than a third as much as previous units. Aluminum is used extensively throughout and the unit is so designed that it can be transported—in sections—by helicopter to remote areas.

Cathode-ray tube that stores images, keeping them invisible . . .

. . . for as long as 20 minutes, and then displays them on "demand" when the screen is flooded with infrared light from an external source . . . is one of many new developments coming from the Toronto laboratories of Ferranti-Packard Electric Ltd. Among the others: new solar and photoelectric cells; and a host of computer components, including magnetic drums with air bearings, and new tape spoolers and tape readers.

The cathode-ray tube is said to provide pictures "as good as those normally associated with TV," and to permit building up the image, element by element, at relatively slow speed. Brightness and persistence of the final picture can be controlled by adjusting the intensity of the infrared beam.

Ferranti says the new tube is considerably less expensive than other "visual storage" systems, and expects it to find application in facsimile transmission as well as radar display. In the latter, its long afterglow should be particularly valuable.

How many instruments can be packed in the shaft of a needle . . .

. . . Canadians seem determined to find out and have made a good start with the instrumented nose cone pictured here. Almost 5 ft long yet barely 7 in. in dia, it's designed for studying infrared radiation in the sky—essential background data for infrared detection systems now being developed. Photo shows what goes into the cone: a 4- lens and a 2-lens optical system, plus telemetering and transmitting units, and battery power supplies. In test firings, the Canadian Defence Research Board's Armament Research & Development Establishment says, it is possible to determine the position and velocity of the rocket "within a few feet" throughout its flight; and much valuable data is being obtained. —ARG

Instrumented nose cone features a nose cover fitted with a timer that slides it forward, as shown here, at the desired moment. This exposes the optical equipment.

greater heat resistance

Buna N/Nylon Reevecote lasts twice as long at elevated temperatures—with no added costs!

When it comes to taking the heat, you just can't put regular diaphragm material in the same class with this new development from the Reeves-Vulcan laboratories.

Over the past two years, extensive tests compared the performance of the new Heat-Resistant line with standard coated fabrics. The tests proved conclusively that **the new Reevecote line provided up to 100% improvement in resistance to stiffening and cracking.** The new fabric has improved resistance to oils, solvents and gas condensates.

The new Reevecote Heat-Resistant line is now available in twelve different combinations of gauges and tensile strengths. For **all** your requirements, you can be sure if you specify Reevecote, **the one complete source of engineered industrial coated fabrics.** For specifications on the complete Reevecote line, write for **free catalog** — no obligation.

Another

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DEVELOPMENTS TO WATCH...

Washington

Watch for more hassling . . .

soon to come over the Air Force's new make-or-buy contract regulation. The measure, hotly debated for months between industry and Air Force, was slapped into effect in December.

At the time, Air Force asked industry to live with the regulation for at least six months before raising a fuss about it. But, some big defense contractors don't want to wait that long. They are getting set now for new rounds of bargaining on the issue.

The Air Force regulation tightens control on subcontracting by price contractors. Generally, it requires the prime contractor to submit a detailed list of items that are to be subcontracted on a new project when the contract is originally negotiated.

Then, the contractor can't make changes to this list without providing extensive justification to the Air Force. It is this point that the contractors are objecting to most. They claim it means needless paper work and delays. Air Force, however, wants to keep this type of control on projects, particularly where government plants are involved. Plus, the service says, the measure will insure a spreading of the defense dollar to more small business.

Army has formed a top-level ad hoc committee . . .

to take a hard look at the service's R & D policies—and come up with shortcuts on how to cut lead time.

It is the first such committee that has ever attempted to cut through the layers of administration on R & D contracts with definite instructions to come up with specific speedup recommendations.

General Arthur G. Trudeau, chief of research and development for the Army, is personally keeping a close watch on the committee. It started its round of skull sessions on February 4, and must report back to Trudeau on March 10 with initial results.

The committee is expected to set up two separate procedures on handling R & D items. One will deal with priority projects, the other with nonpriority items. Emphasis is on pushing priority projects.

The committee is expected to recommend such things as a shift to more special project officers—much like the Navy's Polaris special projects system. concurrent testing of items by the developer and the Army, etc.

Right now, the Army estimates it takes an average of 8 to 9 years to work a program from the development stage to production. Here is how the time is spread: concept evaluation and approval, 18 months; development, 54 months; testing, 29 months, production, 18 months.

First tests to put a manned satellite into orbit . . .

have been started. The Air Force is conducting parachute-drop tests using a dummy capsule similar to the one that will eventually carry a man into space and bring him back.

Within the next few weeks the National Aeronautics and Space Administration will begin testing the escape system at its Wallops Island, Va, facility. It will be another couple of years before the first attempt is made to orbit a man.

Final negotiations are being conducted now between the NASA and McDonnell Aircraft Corporation to build the capsule for the manned space shoot—dubbed Project Mercury. Cost is estimated at more than $15 million. The capsule will be launched by a Convair Atlas-D missile booster and guided from the ground into a near circular orbit between 100 and 150 miles in space.

Here is how NASA expects to bring the manned capsule back to earth: At reentry time, the capsule will be orbiting at 18,000 mph. Retro-rockets will be fired to slow it down to 17,600 mph; the rockets will be jettisoned and the slowed-down capsule will start an elliptical path toward earth.

About 10 minutes after the retro-rockets are fired, the capsule will enter earth's atmosphere at an altitude of roughly 60 to 70 miles. In another five minutes it will descend to an altitude of around 10 miles; by this time the capsule will be traveling at subsonic speeds.

When the capsule is at the 10-mile altitude area, a drogue parachute will be fired to slow it down even more; when it reaches the 5-mile altitude area, a larger parachute will be fired to float the capsule to earth, most likely for a water landing.

About 10 test shoots, a half dozen carrying animals, will be fired before an attempt will be made to orbit a man. First full-scale reentry attempt will be made with an animal.

WHAT'S HAPPENING IN... Science

Where are the planets?

That's a serious question being asked by space flight experts. Though measurements of planet distances and locations have been refined over the years, they still aren't nearly accurate enough. On the basis of current data, a spaceman couldn't even be sure of getting within 50,000 miles of Mars.

As G. P. Sutton told a USAF symposium at Southwest Research Institute, much still remains to be learned about the exact densities, orbits about the sun, gravitational influence, and even the size of the planets before successful space flight can be achieved.

Both the learning and the doing are going to call for vastly improved instrumentation.

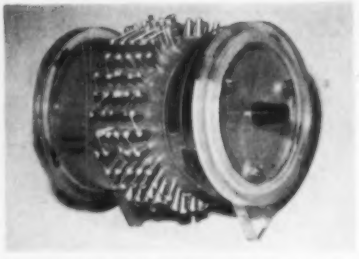
The degree of improvement needed in reliability as well as accuracy is much greater than many people realize. "For many space missions," Sutton said, "vehicles are going to be in orbit for long periods of time . . . and the order of reliability that will be required . . . will be equivalent to locking a machine in a room of somewhat unknown environment and leaving it to operate without attention for a period of perhaps 3 years.

"Would your automobile," he asked, "be capable of running 3 years continuously if it were locked in a garage?"

Atoms & thermocouples add new power

Thermoelectric devices with efficiencies of "10% and higher" can be built, say engineers at Rome Air Development Center, using radioisotopes as the heat cource and semi-conductors (zinc, artimonide and bismuth telluride, for instance) for the junction materials.

In basic concept these RADC devices (see photo) are similar to the nuclear thermopiles developed at the AEC's Mound Laboratory (*PE*—Aug 11 '58, p 5). However the RADC models are said to require only about ⅛ the number of junctions to achieve the same output power. Both take advantage of the heat generated by radioactive decay—the heat is wasted in many radioisotope applications.



New RADC thermoelectric device is designed to put atomic heat to work.

Right now, simulated heat sources are being used; but one model, at least, has shown output voltage of 5 v, with a current of 40 ma.

(Note: for information on another way in which radioisotopes can be used to produce useful power, see "Midget Batteries," *PE*—May 12 '58, p 72; and for more on thermoelectric generators, here and abroad, see *PE*—June 30 '58, p 10; July 14 '58, p 8, and Dec 1 '58, p 10.)

How they beat the heat

Why do some organic materials do considerably better than inorganics like glass and metal as heat barriers at ultrahigh temperatures? Here's a new explanation that may provide a key to even better materials:

It's been shown (*PE*—June 16 '58, p 5) that nylon-reinforced plastics will stand up to temperatures in the 6000-to-12,000 F range at least twice as long as will materials reinforced with glass fibers; and other all-organic laminates also do surprisingly well at very high temperatures.

One theory is that heat consumption in dehydration of the organic molecule delays disintegration. Many plastics have a high molecular water content and absorb heat during vaporization of this water.

But this may be only part of the story. The surface carbonization that occurs when the plastic is hit by a sudden burst of ultrahigh temperature may also help to delay disintegration by serving as a protective layer. Furthermore, engineers at Bjorksten Research Laboratories who have been studying this effect note that the carbonization is accompanied by formation of gas bubbles just under the surface. These, they believe, may act as thermal insulators, retarding further penetration of the heat in all-organic materials.

In materials reinforced with inorganic fibers, on the other hand, there is no carbonization or gasification, but rather a melting away, leaving openings in the surface through which heat is channeled.

Bjorksten engineers are testing these theories in design of a reinforced plastic pressure vessel which has already stood temperatures to 6000 F and pressures of "several hundred thousand psi"; and research in this area is continuing.

Explaining those radio blackouts

It's well known that sunspots and radio communication are related. But the "how" and the "why" of solar interference with radio communication have not been fully explained.

Now, though, Hugh Odishaw of the National Academy of Sciences reports that Naval Research Laboratory rocketeers have pinned down the culprit: X-radiation given off by the sun at the times solar flares appear. Surprisingly, a marked increase was observed in this type of radiation, and none in the ultraviolet range. NRL researchers believe it is this X-radiation which ionizes the atmosphere and so plays hob with radio-wave propagation.

Incidentally, this is only one of several IGY studies which indicate that the sun has a much more direct and extensive effect on our atmosphere than was previously thought. Indeed, it now seems that the sun's atmosphere (corona) itself actually extends to meet our own. —ARG

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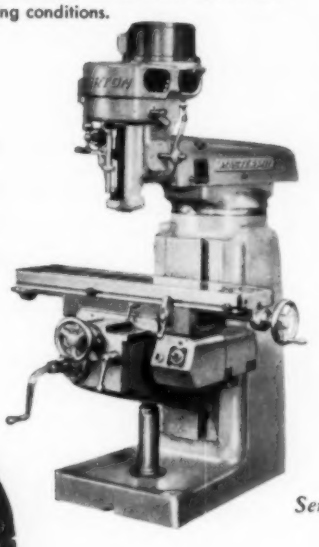
FRACTIONAL HORSEPOWER AJUSTO-SPEDE® DRIVES

Parker Majestic No. 2 Universal Grinder is equipped with two Ajusto-Spede Drives. One drive, mounted on the headstock, rotates the work against the grinding wheel. Another drive operates the table feed. Both work speed and table speed are infinitely adjustable to suit varying conditions.



A Dynamatic Ajusto-Spede Drive provides infinitely adjustable table feed speeds on a Gorton Mastermil. Stepless adjustment permits the operator to select the proper table speed for maximum efficiency in machining all metals.

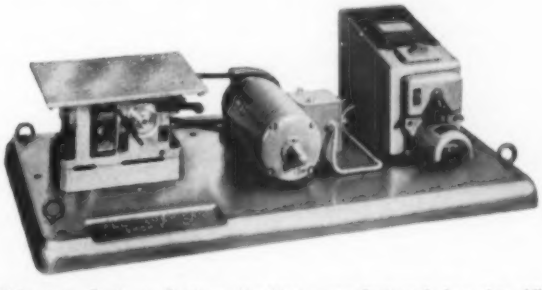
Harnischfeger Welding Positioner WP-1 uses an Ajusto-Spede Drive and gear reducer to rotate welding table. Table speeds are infinitely adjustable from zero rpm to 4.47 rpm. Drive tilts with table to the position desired by the operator.

Wherever infinite adjustment and accurate control of speed are required for proper machine operation, satisfied users are realizing improved machine performance and product quality through the use of Dynamatic Ajusto-Spede Drives. Stepless adjustment from zero to full output speed, and accurate control of any speed within the range, permit operation at the exact speeds required.

Ajusto-Spede Drives operate on standard 115/220 volt alternating current, requiring no special power source. The compact drive with its integral control system needs no wall space, and requires little space on the driven machine. These drives may be mounted in any position, providing great versatility of application. Twelve models are available in ratings from 1/4 hp at 1650 rpm through 1 hp at 3200 rpm.

Before you specify a fractional horsepower drive for your product or plant equipment, check the many advantages offered in the Dynamatic Ajusto-Spede Drive.

Send for Your Free Copy of Illustrated Bulletin FAS-6 which Describes Dynamatic Ajusto-Spede Drives



Vibration Fatigue Testing Machine manufactured by the All American Tool and Mfg. Company employs an Ajusto-Spede Drive to operate a vibrating table at various speeds for testing instruments and electrical components.

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WHAT'S HAPPENING IN... Materials

More price cuts for plastics

As predicted (*PE—Jan 12, p 18,* and *Feb. 2, p 14*) plastics prices are going downhill—result primarily of increased competition in the industry. Latest to sport new price tags: linear polyethylene and polypropylene. Both, cut last year, are now down again.

Linear polyethylene, the newer, more-rigid form of the familiar thermoplastic, is now at a low of 38¢ a lb for the natural molding resin, just 3¢ more than the regular type. Colors are 44¢ a lb. A year ago, linear polyethylene's base prices were 47¢ and 53¢ a lb.

Polypropylene, a member of the same plastics family, was 56¢ a lb when its first pricelist appeared, less than a year ago. Now, it can be had for only 42¢ in natural. Colors that were 65¢ a lb then are only 51¢ now.

Another price cut for polystyrene may be in the cards too. Styrene monomer, from which the plastic is made, has just been dropped another 5½%—to a new low of 12¢ a lb. Last year's price: 16¢.

Next electrical, structural material?

Hafnium carbide—and the borides, nitrides, and silicates of this once-rare element—rate consideration as both electrical and structural materials, says Carborundum's Research & Development Div.

Pointing out that hafnium-tantalum carbide has the highest recorded melting point for ceramic materials (above 7000 F), Carborundum suggests "the field of high-temperature ceramics is wide open for hafnium."

Several hafnium compounds also have interesting electrical properties. The boride, for instance, has a resistivity of only 10×10^{-6} at 32 F. This rises with increasing temperature, but even at 4750 F is only 104×10^{-6}. (Melting point of this material is about 5550 F.) The resistivity of the carbide at room temperature is considerably above that of the boride; but it rises less rapidly. At 5250 F, it is still only 195×10^{-6}.

Hafnium itself is a rare metal, available only in tiny quantities until a few years ago. Now, though, as a result of the atomic-energy program (it is produced as a byproduct of reactor-grade zirconium), it is in rather abundant supply. It also shares several of zirconium's good qualities: corrosion resistance, strength, and ductility; and its melting point is over 300 F (*PE—Mar 17 '57, p 66*).

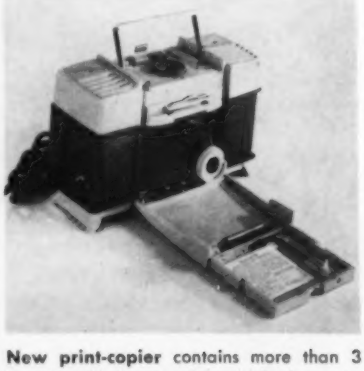
New tricks with old standbys

The brand-new materials get the headlines, but the old faithfuls may still be the soundest choice for many new products—particularly when new forms and new types become available.

Malleable iron provides one good example. The Malleable Founders Society says a new coining technique applied to big (12 to 18-in.) bead rings for bus, truck, and railroad car airsprings, is making it possible to meet "unusually exacting tolerances" at low cost. The coining, which replaces machining, is applied to the ID, face and top sectional area of the rings and brings them within the specified tolerances of plus or minus 0.0075 to 0.010 in.

Steel is another example. Just when titanium, sporting new "all-beta" alloys that develop tensile strengths to 240,000 psi, seemed to have passed steel on a strength-weight basis, along came new "warmer-working" steels (*PE—Nov 24 '58, p 21*) that promise tensile strengths in excess of 400,000 psi; and the battle is joined again. Both materials, incidentally, are said to retain their strengths to temperatures below minus 300 F.

In plastics, too, the value of "old" materials is being demonstrated. For instance, American Cyanamid notes that Polaroid Corp designers have chosen Beetle urea formaldehyde plastic for the case and 10 other parts of their brand-new portable print-copier (see photo). This was one of the earliest plastics, "surpassed" many times by newer materials; but now celebrating its 30th anniversary. The reasons: no other material matches its combination of colorability, hard surface, stain resistance, and relatively low cost.



New print-copier contains more than 3 lb of molded urea formaldehyde parts.

briefs . . .

Uranium colors are ready for use in civilian products, Vitro Corp announces. These are the brilliant, long-lasting oranges, yellows, and greens, long used by the glass, ceramic, and porcelain industries; but unavailable since the start of the Atom Age. Now, Vitro is making them from "depleted" uranium released by the AEC (*PE—Jan 6 '58, p 34*); and has a research program underway to develop other non-nuclear uses for the materials.

Closer commercial tolerances on cold-finished steel bars—and especially on heat-treated and stress-relieved materials—are promised by Bliss & Laughlin. New manufacturing processes, the company says, make it possible to cut the tolerance for undersize variation 10 to 50%. Rounds of over 0.55% max carbon content, for instance, can now be held to 0.005 in. (former tolerance, 0 to minus 0.006), hexagons $\frac{7}{16}$ to $\frac{3}{4}$ in. to 0.006 (from 0.008) squares in the same size range, to 0.007 (formerly, 0.010). —ARG

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Advantages:

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- **Stationary Coil**
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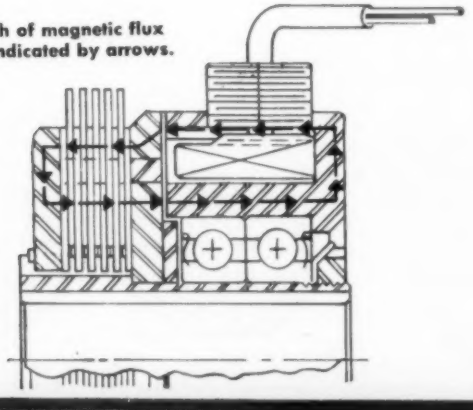
OPERATION INDUCED ENTIRELY BY *Magnetic Flux*

The new Maxitorq #9000 Series Electric Clutch is a compact, self-contained unit with operation dependent upon induced magnetic flux. As shown in the drawing below, this new Maxitorq Clutch consists essentially of a sealed magnetic coil and housing arrangement actuating multiple discs which also act as the flux path. Because the coil housing, supported on anti-friction bearings, is stationary, troublesome brush and slip ring construction is eliminated. When energized, the entire assembly consisting of pressure plate, inner and outer discs, and buttress plate is locked together by the magnetic force passing through it. When de-energized, Maxitorq separator springs instantly separate the discs creating air gaps which help to break up residual magnetism. Compactness, fast response, and flexibility of control make the #9000 Series clutch or brake ideally suited for a wide range of applications.

Path of magnetic flux is indicated by arrows.



Write, phone, or wire Dept. PE now for Bulletin 90 describing the most advanced design of electric clutches or brakes available today.

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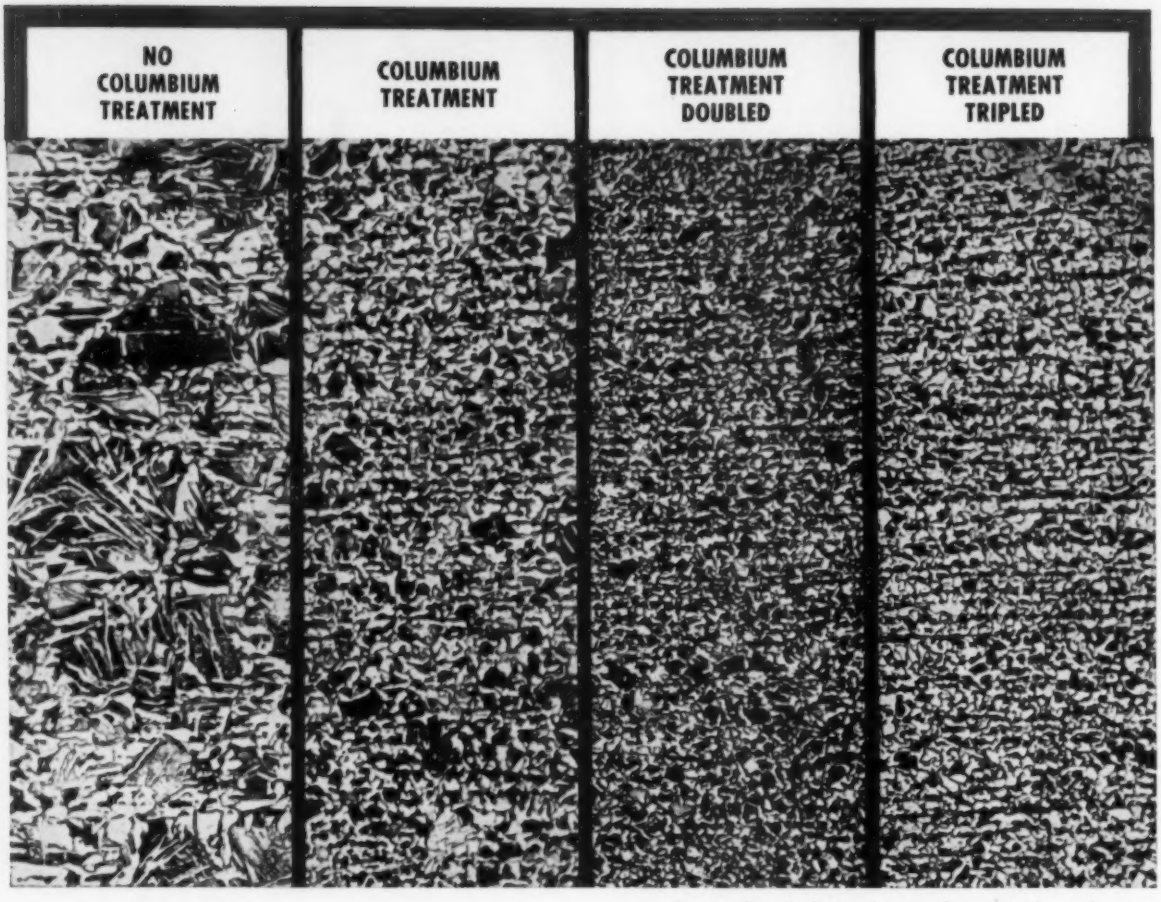
HOW GREAT LAKES



Composite of photomicrographs made from the same heat of mild carbon steel shows the effect of varying columbium treatments on the grain structure of the steel.

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N-A-X FINEGRAIN STEEL

Lets you design superior performance, longer life and less weight into your product. Many diversified applications.

N-A-X HIGH-TENSILE STEEL

Offers all the characteristic features of N-A-X Finegrain, plus greatly enhanced resistance to atmospheric corrosion.

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STEEL CORPORATION'S NEW GLX-W STEELS GIVE ... HIGH STRENGTH TOUGHNESS REDUCED COSTS

Key to the success of Great Lakes' new GLX-W Series of steels is the fine grained internal structure produced by treatment with columbium. This grain refinement also contributes to ductility. And in addition, the GLX-W Series' low carbon and manganese content assures excellent weldability with freedom from underbead cracking under all conditions.

COST AND WEIGHT SAVINGS

Where design permits the replacement of carbon steel with GLX-W steels, weight savings of 20 to 35 per cent, and cost savings of 10 to 25 per cent can be realized. When replacing alloy steels the cost savings can range from 25 to 35 per cent. These steels feature higher yield strengths, greater tensile strengths and increased toughness without costly heat treatments or extensive alloy additions.

The GLX-W Series is so priced that substantial cost reductions can be obtained by weight reduction over mild carbon steel. Cost reduction can also be obtained over alloy steels because of the lower price of GLX-W steels.

STRONGER AND TOUGHER

GLX-W steels are stronger and tougher than ordinary mild carbon steels and in some applications can do the job now being done by the more costly alloy steels.

MANY USES FOR GLX-W STEELS

GLX-W steels are especially recommended for a broad range of applications in mobile equipment and pressure vessels, as well as the transportation and construction fields.

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CIRCLE 58 READER SERVICE CARD

from contact shoe beams . . . to ship fenders . . .

GAMBLE solves problems with WOOD!

Contact shoe beams on subway cars hold the apparatus for picking up power from the third rail. The problem: could wood (with its obvious advantages) hold the required dimensional tolerances and provide the necessary dielectric strength? The answer: yes, in the form of a laminated hard maple beam engineered by Gamble Brothers.

The "ship fender" problem was different. Who in the world had the wood-engineering knowledge and physical plant to produce the "king-size" wood laminations? The answer again: Gamble Brothers.

Design problems like these are "all in a day's work" to the wood engineers at Gamble Brothers —a unique organization designing and building a wider variety of wood products than any other U. S. woodworking company. Today they're working on projects in three principal areas: (1) improvement of present wood products (2) development of new wood products (3) product development in combinations of wood and other materials.

Why not present *your* design or component problem to Gamble Brothers? WOOD may be the answer!

FREE booklet illustrates GAMBLE services

This 28-page booklet describes Gamble facilities and services in detail. Includes many photographs of unusual products designed, tested and perfected by Gamble Brothers. Write for your copy today! Gamble Brothers, Inc., 4617 Allmond Ave., Louisville, Ky.

If the problem involves wood, Gamble can help!

GAMBLE BROTHERS, INC.

4617 Allmond Avenue, Louisville, Kentucky

Product Engineering

HORIZONS

FEBRUARY 9, 1959

the MADMEN of INDUSTRY

Gunpowder is a familiar force, so it was with no real surprise that I heard, almost thirty years ago, of a gun that shot studs instead of bullets. Newport News Shipbuilding had developed it for applying patches on hulls under water. But a score of years went by before the gun came out on land and was developed into a stud driver for concrete or what have you.

Several years ago, other men began to apply the principle—for punching holes in hard steel, for forming difficult materials, and, so on. Lockheed did some noteworthy experimental work, using rifle and shotgun shells and even the rope-like explosive duPont developed for the Rangers to destroy bridges and cut down trees during World War II (Jan. 6 '58, p 56). The technique is to put a measured quantity of explosive inside a chamber of which one wall is the blank or the back of a punch. Several companies began to form heavy steel that way. Explosives makers and others became interested. Now, some users have taken to firing the explosive charges under water, because the water distributes the pressure equally in all directions.

Thus we have a full-fledged technique developed, one that challenges the heavy-press program for forging and forming, that shapes metals or punches holes in them before the metal "knows what hit it," as Glen Rardin of Lockheed told me.

Convair has been experimenting, meanwhile, with another way of generating explosive forces—a compact unit that releases high pressure into a confined area past an orifice. This produces a shock simulator that can be set for any type of pressure buildup, but it also produces a press that does in effect what the explosive force does.

These two examples are but indicative of the many latent possibilities in application of the principle of suddenly released, directed force. They are, in effect, devices by which the tools become the key element, while the otherwise-necessary huge press is replaced by a compact power package which destroys itself each operation.

Here again is the trend to miniaturization of power as in the tiny dry batteries, transistors, nuclear and solar power plants. While the "packaged-power" processes are not yet economical for quantity production, they are already in use for one-of-a-kind and small-lot production, special materials, difficult shapes.

But there is a more important engineering lesson here, too. Neither process is the product of a company already in the field—one presumed to know the jobs to be done. Each had to come from outside, fighting uphill against a fixed and unreasoning belief that what we already have is the best available.

It is an axiom in medicine that many of the new drugs and techniques are not developed by doctors. The same comment has been made about dentistry, the law, and other professions. It is the outsider, the newcomer, who in many cases not only sees the star but hitches his wagon to it. He is the madman who makes it work.

Kodak reports on:

what happened on August 22, 1946... a large optical device... a device with enormous potentialities for inventiveness

Photoplast plates

Rohm & Haas and we are putting on a little promotion. They are the people who make optically clear methyl methacrylate sheets under the trademark "Plexiglas." We are the people who try to make the world's most dependable photographic emulsions under the trademark "Kodak."

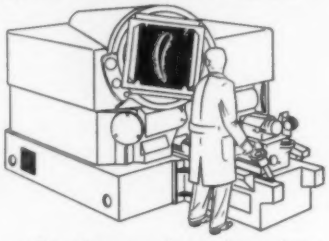
The promotion draws attention to the result of coating one of our emulsions on their methacrylate, "Plexiglas," to produce *Kodak Photoplast Plates.* The plates went officially on sale on August 22, 1946. You could have placed an order for them the next morning if you had known about them and wanted some. No special reason for delaying the promotion till now. The matter just hadn't struck us as urgent until Rohm & Haas phoned us about it the other day. Ever eager to see "Plexiglas" moving along the arteries of trade with or without photographic emulsion on it, R & H wanted to tell their field sales force about *Photoplast Plates.*

Then, even before we got around to deciding that this would be fine with us, came another phone call about *Photoplast Plates* from one of the smarter firms in the electronics business. Originally they had inquired about circular glass plates which would accept photographically a fine-detail pattern. Link by link, the chain of correspondence had led up to *Photoplast Plates.* They can resolve better than 200 lines per millimeter, machine beautifully in broad daylight after exposure and processing, are easy to cement with recommended solvents and are easy on the nerves of artisans and engineers afflicted with slippery fingers. The electronics executive on the phone was beside himself with enthusiasm at the analog-to-digital code wheels he had fabricated with them. He was also popping with ideas for putting computer programs on them in optical form. Whether he was going to read the programs with multiple arrays of tiny *Kodak Ektron Detectors* he didn't say.

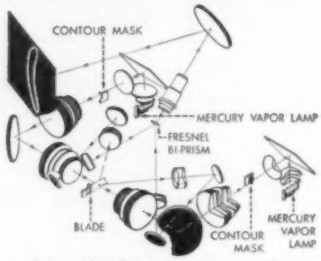
Very well. We hereby advertise (and Rohm & Haas salesmen are free to disclose) that Kodak Photoplast Plates *are for sale in any desired rectangular size from 4" x 5" to 20" x 24" and in thicknesses of 1/16", 1/8", and 1/4". Prices and technical details on application to Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y.*

For blades (also vanes and buckets)

Many mathematical minds, mighty mathematical machines, and much aerodynamical experimentation have created the shape of a blade from a jet engine. Violation of the plan to the extent of a few thousandths of an inch in a single cross-section of a single blade sucks at efficiency like a little leech. And there are so many blades in a single compressor or turbine that the total number of them made in the brief span of air-breathing non-reciprocating history must compare with all the wooden spokes in all the wagon wheels of all the supply trains in all armies since Alexander the Great. Tolerances on wooden spokes have always been broad.

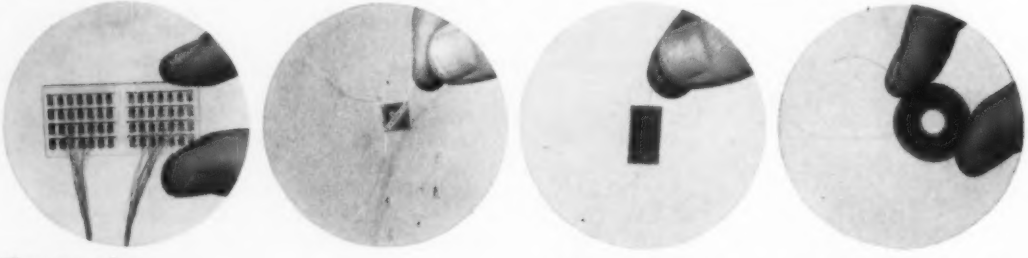


Therefore we have been busy lately building this large optical device. It works as follows:



Recently the two mercury lamps were turned on and the first cross-section of the first blade was seen in magnification against its tolerance envelope scribed on the screen. Inspection from now on should go well.

The device has been named Kodak Section-Profile Projector. *It is enough to restore faith in the future of geometrical optics. Inquiries go to Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y.*



They transduce

We make *Kodak Ektron Detectors* like these for transducing a visible or infrared pattern into electrical terms. The darker material is photoconductive lead sulfide or lead selenide; the electrodes (actually evaporated gold) appear grey here. Since we can lay down the photosensitive material in any configuration, enormous potentialities for inventiveness present themselves. Whether you seize them is entirely up to you. We offer a pamphlet, "Kodak Ektron Detectors." You get it by writing Eastman Kodak Company, Special Products Division, Rochester 4, N. Y. It describes what spectral sensitivities and time constants can be selected and very, very briefly summarizes the circuitry considerations—a little rough, perhaps, for persons with casual interest in this sort of thing. It does tell enough to place an order for breadboarding purposes or a request for quotation.

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

Kodak
TRADE MARK

Soviet Plastics R & D in High Gear, But Large Scale Production is Some Distance Away

A US plastic expert evaluating Soviet progress to date based on first-hand observations finds:

- **Russians keeping abreast of us plastic-for-plastic at the R & D level; should catch the US in 10-12 years.**
- **Production rates are low by US standards, although fabrication plants are efficient and well-run.**
- **Soviet R & D personnel follow US plastics literature avidly; and are puzzled why we don't follow theirs.**

James E. FitzGerald, Manager of the Reinforced Plastics Div of the Brunswick-Balke-Collender Co, who was a guest of the Russian plastics industry.

MARION, VA.—"The Soviet plastics industry, while short on production, is well advanced at the R & D level—ahead of the US in some areas," says James E. FitzGerald, manager of the Reinforced Plastics Div of the Brunswick-Balke-Collender Co. "One point where they lag is in fiber-reinforced plastics. However, if they apply pressure to the plastics industry—as they did to their steel industry—there's no reason why they can't catch up with us in 10-12 years."

Mr. FitzGerald's view of the Russian plastics industry was gained as a member of an 8-man team from the US plastics industry that visited Russia last year. In December his group hosted a plastics delegation from the USSR.

Mr. FitzGerald described his visit to the Russian plastic firms at a meeting of the Society of the Plastics Industry in Chicago last week. For detailed information on Russian design experience with plastics, PRODUCT ENGINEERING posed the following questions to him prior to his talk:

• How much original work have the Soviets done in the development of new plastics materials, processes and fabrication?

"Their potential in this field is immense. They have the ability to 'turn on any valve' they want, and they have just recently turned on the valve in plastics. Their plastics industry is old, but was neglected while they ran forward on the iron and steel industry. To catch up rapidly, they're out to buy from the Western countries entire plastics processes—polypropylene, for example—and bring in the complete package, engineers too.

"There was a great gap between the institutes doing the development work and the actual production operations. This may be their greatest problem."

• What are some of the products that you saw being made?

"In the Carbolit plant I saw phenolic laminate sleeve bearings about 18 in. in dia, cellulose acetate steering wheels, polystyrene trays, and phenolic laminate electrical panels. At the Vladimir Chemical Plant extruded PVC pipe up to 5 in. dia, and valves and fittings machined from molded rigid PVC; chemical pipe and fittings made by wrapping around PVC cores, and molded impellers for chemical pumps. Asbestos-filled phenolic pipe is in great demand by the chemical industry.

"At the Okhta Chemical Combine in Leningrad, nitrocellulose toys are blow-molded, with mechanized finishing and packing. Also, vinyl plastic is used for battery separators, and ethyl cellulose for steering wheels, radio parts, electrical varnishes and insulation. Eight types of epoxy resins are employed in adhesives, coatings, and laminate impregnation.

"The Komsolmolskaya Pravda Plastics factory in Leningrad is primarily a thermosetting molding plant producing phenolic and urea dinnerware, handles, toilet seats, and industrial and electrical goods. At the Leningrad Laminates plant, phenolic, urea melamine and polyvinyl resins are used for coating paper and fabric and decorative and electrical paper laminates. USSR produces about 20,000 tons of laminate annually.

"In reinforced plastics they are probably the farthest behind us. Their major progress is in the aircraft field. For example, the solid laminated epoxy plastic fin tip for the TU-104 is similar to the one our company makes for the Boeing 707. Since most of this development is done by the aircraft companies, we did not learn much about it. The Russians talked about a foam-filled sandwich honeycomb wall with reinforced plastic faces for use in apartment-house construction.

"We did see laminating plants making phenolic and melamine sheet laminates for counter tops and paneling for bus trim, but the quality didn't appear equal to ours. I didn't see any instrument cases or radio cabinets molded from reinforced plastic."

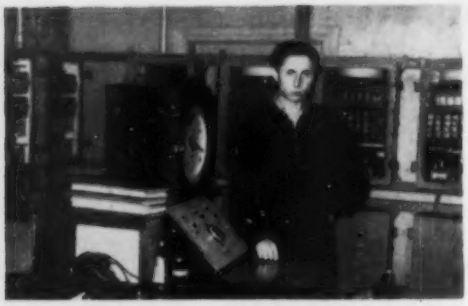
• Are they emphasizing polyethylene as much as the US?

"Yes, they are—very much so. They have practically no polyethylene production and are very much interested in our developments to satisfy some of their urgent requirements—particularly in consumer goods. While they are behind us in the field, they are doing extensive research and pilot plant work. And they do emulate us.

"In polyethylene a recent change in policy is taking them into more consumer goods—obviously this is a way to please the people." (During his recent visit, Russia's Deputy Premier Mikoyan showed much interest in our plastic consumer goods.

• Are the Russians making use of our technical developments?

"Yes. This is obvious. At one plant



Automatic control and check station for all presses in plant at the Komsomolskaya Pravda Plastics factory in Leningrad. Temperature on either platen of any press in the factory can be determined and recorded in seconds.

they knew more about the content of some of our recent technical magazines than did some of our group. One engineer asked me about an article on reinforced plastics appearing in the previous month's issue of one of our technical journals. They get all of our magazines, and Russian library groups translate them into Russian and send collections of the latest articles in a particular field to engineers at the institutes. Very few companies have arranged to do this.

"They asked us why we weren't familiar with their magazines. When one of our people said that we don't know how to get Russian magazines the director of the chemical industry said, 'If you want one, just subscribe to it!' The language barrier, though, is still the real problem to us but in the plants we visited we usually found about three out of ten in top management who spoke and read English. In the institutes this rate was higher."

(Several of the US firms accepting subscriptions to Russian technical journals are: Imported Publications & Products, 4 W 16th St, NY 11, NY; Four Continent Book Corp, 822 Broadway, NY 3, NY; Victor Kamkim, Inc, 2906 14th St, NW, Wash 9, DC. For translations, the Office of Technical Services, Dept of Commerce, Wash 25, DC is translating some Russian technical journals on a regular basis.–Ed.)

• How close do Russian design practices for molded parts follow ours?

"They design without regard for competition. For example, some small plastic toys are twice as heavy as ours, and while they last longer, the heavier toys cost more and would not be competitive. But in the USSR, the price is set by the state, not on the basis of production costs, but rather on demand and who they want to have the item. Prices on their plastic products are fairly expensive compared to ours.

"This overdesign is not caused by an inability to get melt viscosities and so on; rather, it is a lack of definitive selling. A Russian designer might be severely criticized if his product wouldn't stand up well, even if it meant a savings in resin. So, they tend to play it safe."

• What work is being done in plastics research?

"At the Scientific Institute of Polymerizing Plastics in Leningrad the Polystyrol Lab has developed a number of copolymers and terpolymers of styrene with good injection molding properties and better light stability than methacrylate. The terpolymer has 900 kg/cm² flexural strength and a 15-18 kg/cm/cm² Charpy shock resistance (compared with 8-9 for polystyrene). It was developed for pen barrels, tail lights and other moldings. Also, a copolymer of styrene and methyl rubber (5-20%) has good impact (100 kg/cm/cm²) and is similar to Kralastic.

"The Fluorinated Compounds Lab has developed Thoroplast IV (similar to Teflon) and Thoroplast III (similar to Kel-F). This lab has completely investigated all substitutions of ethylene and is now concerned with copolymers and other monomers.

"Work at the Karpov Research Institute in Moscow is mainly in high polymers. The Institute of Plastic Research and Development in Moscow stresses the application and development of new uses for plastics. Here I saw epoxy and silicone laminates, 400 F polyesters using methyl methacrylate mixtures, 20-ton boats made from mat and cloth with thixotropic polyester for layup. Epoxy molds are just being investigated. I saw several samples of honeycomb made from glass cloth, cotton fabric and paper. The quality was poorer than ours, cells were irregular and resin content varied. Phenolic resins are being used exclusively."

• Are they ahead of us in any area?

"No–not really. I was quite familiar with most of the things I saw. They have made rapid advances in a relatively short period of time, particularly in the research area and are working in almost all the areas where we are. But they do have high impact styrene copolymers, which we do not have yet.

"Fluorinated plastics is another area. We thought we were head and shoulders above everybody else, but the Russians have developed manufacturing techniques and are turning out tubing, gaskets, coated wire, and cloth of fluorinated plastics. They have all the compounds we have and are talking about other applications beyond any we have in production, such as elastomers, cloths, etc."

• What do you think of their production and fabrication equipment?

"They do an excellent job with equipment that we would have thrown on the scrap heap long ago, particularly the presses. But they do have some new Russian-built injection molding machines that look very good, and appear to be patterned after German machines. They are interested in buying new equipment such as automatic preform machines, reinforced plastics mat machines, and honeycomb machines.

"Their method of making molds is good, and the quality excellent; mating parts, for example, showed excellent fit. They spend labor to get a superior finish where it will increase mold life. Their molding techniques showed ingenuity, particularly the automatic opening, multiple-cavity molds used with phenolics. Usable parts with minor visual defects that would cause rejection here are not thrown away in Russia. They may reprimand the operator who made it,

An 8 oz injection molding machine at the Karacharovo plant in Moscow.

but they don't throw it away."

• Has the technical "cold war" been effective?

"I'm sure that our refusal to sell them machines and processes has hindered them, but we cannot keep them behind us. The people we talked with in the Institutes are experts in their particular fields and their basic training is good. Our only answer is to forge ahead ourselves. We should recognize this. I know that this has been said before, but we underestimate the Russians' intelligence and ability; whether we like their political system or not, here is a real potential competitor. I don't think they will compete with us for some time, because their own needs are so great. Actually, most plastic products are consumer items, and people in the US are relatively flooded with them.

• Are they using plastic tooling techniques?

"Yes, and while I didn't see a lot in use, they were using a filled epoxy for plastic boats and dies for metal forming. I saw some of these dies in an automotive exhibit we happened to visit. We didn't get into any of their metal working plants."

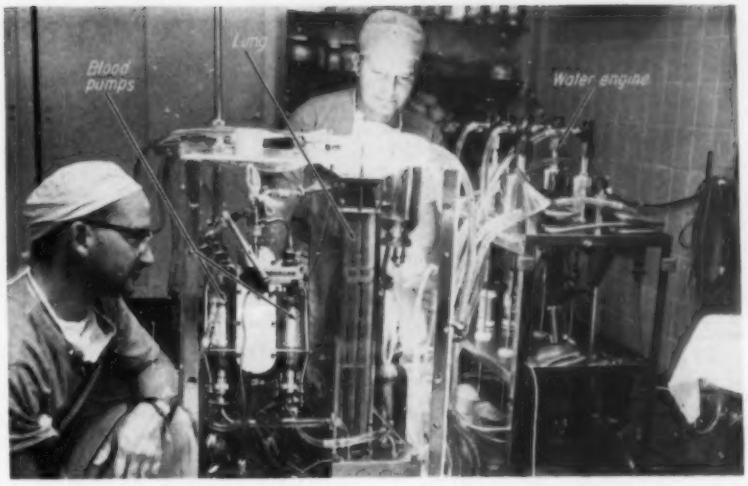
• What about production rates and control techniques?

"In some instances their automatic control methods are elaborate. In one molding plant all of the presses, about 300, are connected to a central control room so that the temperature on any platen of any press can be read by dialing a number (above left).

"Some presses are automatic or semi-automatic, and each man operates several presses. In US, it would be cheaper to train an operator."

Save time on Minuteman

Los Angeles—Abiding by original planning for the Minuteman Missile Program, Bendix Aviation will deliver the missile to Air Force bases like Vandenberg AFB, bypassing the R&D firing phase. Operational crews at the base will conduct firings from which R&D test data will be obtained. Since Minuteman is designed as a series of cylinders, telemetering instrumentation will most likely be designed into a standard section. Along with obvious cost saving aspects, this procedure speeds experience of regular operating crews who profit by the debugging phase.



Heart-lung machine . . .
incorporates four blood pumps (left) an oxygenator or lung (center), and a water engine (right). It takes over the jobs of the heart and lungs during heart surgery, is the result of a unique cooperative effort between doctors and engineers as . . .

Missile Men Develop Heart Pump

San Diego,—Convair engineers, cooperating with doctors of the Community Hospital here, have developed a heart-lung machine so dependable it can do the work of the human heart and lungs as long as necessary for open-heart surgery. It may also be the answer to the problem of resting a heart so it can do its own repair work after a heart attack, because its rate of destruction of the blood is lower than that of any previous machine.

Several unusual ideas have been incorporated in the unit, which combines medical, physiological, electrical, mechanical, hydraulic and chemical considerations. There are also several new ideas, including the use of water power instead of electrical power to guard against power failure, and an exact metering system. Design considerations include the fact that blood is highly corrosive—may even attack stainless steel, that hemolosis (breakdown of red corpuscles) occurs if the blood is battered by the pump or passes sharp surfaces, and that the blood platelets which cause clotting and coagulation will cling at a hole, pocket, discontinuity, short transition, or even on an extensive glass area. The job, as one engineer explains it, is to pump the equivalent of egg yolks without breaking them.

Built in the Convair experimental factory, the prototype has already been used successfully, and was pronounced by the surgeons and doctors as the best unit with which they had ever worked. Engineers will be particularly interested in the ingenious design details incorporated.

Essentially, the machine consists of four blood pumps in push-pull pairs, an artificial lung (really seven large vertical screens within an atmosphere), matching diaphragm pumps powered by a tap-water "engine", and the necessary controls. These are grouped so the operator can be outside the operating room, reducing risk of power failure and avoiding explosion hazards.

Pump—As sketched, (see p 26) each of the four blood pumps is a bottle-shaped rubber bladder with top and bottom necks. This is placed inside of cylindrical chamber and has ball-check valves at both ends. Balls are of plastic, seating against soft-rubber gaskets. Pumps are in pairs, alternating in what doctors call the suction-expressing cycle. One pair lifts blood from a ready tank and supplies it to the patient on a metered basis under control of the surgeon, while the other pair draws used blood from the veins and delivers it to a tank from which it flows over the lung.

Each rubber bladder is alternately compressed and expanded by forcing saline solution into the chamber around it, then withdrawing it. The saline solution in its turn is pumped

by a diaphragm which is pushed up by tap-water pressure from a water "engine" and drawn down by a simple weight as the water is exhausted. Hot and cold water are mixed from the taps by a thermostatic valve so the exhaust water can be piped around the blood tanks to maintain blood temperature. Thus there is no risk from power failure. Saline solution is metered to give exact indication of blood flow, avoiding flowmeter problem.

Lung—The lung is a Gibbon-type series of seven vertical woven stainless-steel screens. The blood flows over as many of these as necessary in thin sheets within a prepared atmosphere. Engineers improved the oxygenator to get smooth sheet flow (filming) over the screens, and used a much larger oxygenator than has been common heretofore.

Controls—There are three controls: temperature, oxygenation, and pH (acidity). Temperature is controlled by setting the thermostatic mixing valve on the water engine. Drain water goes through the hollow walls of the blood tanks before draining. Temperature is measured by a thermometer and adjusted by manual control of the mixing valve to avoid complications.

Oxygenation is measured by a commercial photoelectric oxymeter which checks the color of transmitted light. The output of the oxymeter feeds a servomotor to change automatically the ratio of oxygen to nitrogen in the artificial atmosphere of the oxygenator. (There is danger in too much oxygen—the blood will saturate with it—90 to 95% is preferred.) Oxygenator atmosphere is also pre-humidified, to avoid dehumidification of the blood.

Acidity—Normal alkalinity of the blood (7.4) is related to the CO_2 content, so the blood is measured automatically as it leaves the oxygenator by a standard pH meter. Meter scale (2 to 12) is expanded to read 7.3 to 7.5, with an added bias to change the center of the scale from 7.0 to 7.4. Output of the meter runs a second servomotor and valve which adds CO_2 to the atmosphere of the oxygenator, thus inhibiting CO_2 evaporation if necessary. (All gas-control systems can be manually operated if the electric power fails.)

Other Systems—A patient may suddenly become acidic during an operation—the blood "goes sour" as a result of a change in basal metabolism. To counter this, a sterile bicarbonate-of-soda system is provided, under remote control by the doctor.

Two suction systems, both fed from the same vacuum pump, return blood from the heart and chest cavities to the machine. One is a low-vacuum system from the chest cavity, the other a higher-vacuum setup from the heart cavity. When the surgeon uses the sucker tube so he can see inside the heart, a special valve is opened to increase vacuum in the pump. The machine is primed with 20 pints of proper-type blood. Only 13 pints are necessary; the rest is insurance.

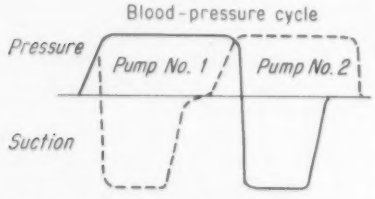
Flow of blood to the body is controlled by the surgeon who clamps or unclamps the arterial tube. If he clamps the tube, the water engine stops or slips like a hydraulic transmission—power water flows out through a relief valve, but pressure is maintained on the blood. A peculiarity of the procedure is that the patient has no pulse—because of the twin pumps with sequencing valves, there is continuous blood flow. The patient's heart can be stopped with drugs if necessary, and his lungs collapsed to get them out of the way—so breathing may be stopped for a time as well.

The pump has already been used successfully. A 44-year-old woman, given six months to live without heart surgery, was unable to find a hospital with a heart pump that could take care of her before that time. She became the first patient to use the new pump. Her heart idled and her lungs were collapsed for 19½ min, during which the machine breathed and pumped blood for her. Her blood temperature during this period varied only ½°, with oxygen, pressure and chemical balance completely normal.

The San Diego machine was the result of 16 months of development work. A group of San Diego doctors had purchased a heart-lung machine, but were afraid to use it. They conferred with Roberts R. Hoover, asst chief engineer at Convair-San Diego and cousin of one doctor, who agreed—and suggested a new design. Then began an involved procedure of deciding what the requirements were for a machine—not aided in the least by the fact that the two disciplines use different vocabularies, and that some engineering words mean something totally different to doctors.

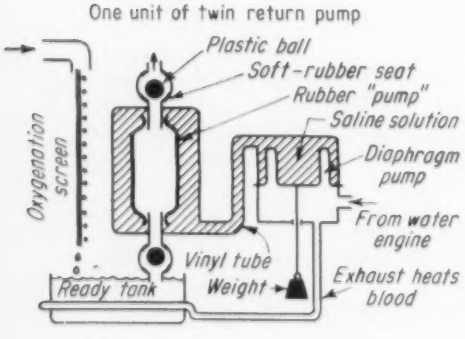
Original work was on a volunteer basis, but too much was involved. So the engineers went to the company. Some money was advanced by Contrib, the employes' social-service group, for an electronic recorder with two oscilloscopes, and more by the company, which agreed to take on the project. The device was built at Convair's experimental shop, partly in off-hours and weekends.

About six months ago, Lawrence Kamm, design specialist in Convair's computer labs, was assigned to supervise the project, and Edward Leak, experimental factory technician, was recruited. William Childs (foreman of the experimental factory) designed the blood pump, Kamm the control system. Doctors and other Convair people made suggestions, donated



No pulse and no breathing . . . need be provided by the patient. Sequencing valves on the twin return pumps maintain pressure of delivered blood almost constant. Intake is not critical, so is done faster and more irregularly. In the other pair of pumps, which handle venous blood, the diagram is of course reversed.

Four units . . . like the one diagrammed here (only one oxygenator is used, however) make up the new machine. Two like this handle arterial blood; the other two draw blood from the patient for the tank from which it runs over the oxygenator.



Ramjet power plant . . .
for supersonic transport is suggested by Marquardt Aircraft. This hypothetical aircraft, says President Ray E. Marquardt, will carry a 100-passenger payload coast-to-coast in 60 min at speeds of Mach 4, and altitudes of 80,000 ft, cruising on ramjet power. Propulsion system would call for afterburning turbojets to provide take-off power to reach ramjet takeover speed at Mach 2 at 30,000 ft. Recent tests made 14 mi above earth indicate ramjet operation is possible in Mach ranges of 6 to 10 and beyond.

time, and proved generally helpful.

While the prototype is satisfactory, the designers feel it is "stronger" than it needs to be—some elements too elaborate, too heavy, too perfect. It could also have added a device to record the patient's brain waves to check normality during the operation.

Britain Ups Its Aid to R&D

LONDON—Government aid to Britain's Dept of Scientific and Industrial Research will be increased considerably in the next five years, according to the Ministry of Works.

Nearly $171 million will be allocated to the Department over the next five years, $70 million more than in the current DSIR five-year plan ending on March 31. By 1963/64, ministry says, the Department's annual expenditure will be about $40 million.

Report Red China Transistor Research at High Level.

BONN—A German source reports here that transistor research in Red China has advanced so far that Chinese production of pure germanium has reached world standard. Outstanding progress has reportedly been made in nuclear science, for which necessary equipment like electrostatic generators and beta ray-spectrometers has been designed domestically. Red China also has a Russian designed 7 mw reactor in operation which is the largest in Asia, and a 25 million electronvolt cyclotron is almost completed.

Soviets Develop Mechanized Reading

VIENNA, AUSTRIA—One million pages per hour can be read by a data machine developed by Soviets scientists for rapid automatic perusal and analysis of scientific and technical literature, according to lastest reports.

Machine is a kind of book depository, and has a device for mechanical reading and reviewing of texts in accordance with request of reader. Text is abridged and ciphered. A special machine translates foreign language text. The questions are fed into a special device and translated into its cipher. Any abstract or article can be selected for mechanical "reading" in the same way as telephone numbers are dialed.

The reading device of the machine picks out the necessary material, looks through it, and sums it up according to question asked. The necessary material is found with the help of literary references and various tables in the "memory bank" of the machine. This machine can be used as a kind of library linked by wire to the readers, who have special TV sets for reading. By dialing the "address" of desired text reader will immediately get its image.

Five NATO Nations to Spend $500 Million for US-designed Missile

PARIS—Five NATO nations of Western Europe have decided to spend as much as $500 million (with US assistance) in building the US designed, low-altitude air defense missile, the Army-Raytheon Hawk.

Involved in the Hawk deal are five European companies representing Belgium, France, West Germany, Holland and Italy. They will be grouped together into a sort of holding company retaining license rights on the Hawk and officially recognized by NATO. This European-wide approach is likely to hold for any future agreements similar to the Hawk deal, being considered the best way to make sure European NATO partners cooperate rather than compete when seeking US weapons.

However, while France was willing to go along with the Hawk program since no similar weapon system

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Vulcan's "Thunderbolt" Cartridge Heater delivers as much heat as a conventional cartridge *five times its size*. You get ratings as high as 40 to 200 watts *per square inch* of radiating surface. Special construction locates insulated resistance wire close to sheath. Temperatures are dissipated rapidly through high temperature alloy sheath without detriment to unit life.

Variety of lengths are available from 1¼" to 10" in ⅜", ½" or ⅝" diameters. Standard length of lead wires is 10".

For more heat in less space, solve your hot problems with *Vulcan Versatility* in "Thunderbolt" Cartridge Heaters. Send coupon for technical literature.

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BEFORE...
Appliance manufacturer installed leg leveling bolt; used square head fastener in crating.
AFTER...
Circle B leg leveling bolt designed with Phillips head, at no extra cost, now does both jobs.

save dollars

with this sense-making idea

LITERALLY thousands of dollars can be saved through the practical application of basic bolt making principles in designing and specifying fasteners.

In the actual case shown, savings were pyramided through reduced inventory, handling, purchasing and production time; while one part was eliminated entirely.

To make this basic information available, Buffalo Bolt Company has drawn on over 100 years of experience to put together a digest of these principles.

You'll find them in our new booklet, "How to specify fasteners . . . and save". Filled with drawings and charts, it makes a handy guide in designing or buying any headed parts.

If you can use a copy, write to North Tonawanda or ask a Field Representative.

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exists in Europe, they probably will refuse to participate in such future programs, preferring that such money be used to finance production of European-designed advanced weapons.

British Scale Austins Longer, Wider

LONDON—British Motor Co's new A55 Austin is 1-ft longer and 2-in. wider than its predecessor. Styled by Pinin Farina of Turin, Italy, the four-door sedan has tail fins and Italian body design.

This Austin is aimed especially at the export markets, hence the emphasis on comfort and eye appeal with more passenger and luggage space, quiet closing doors, more visibility.

Mechanically, the car adds nothing new in engine, transmission or suspension. Independent rear suspension —a strong selling point on the continent—has not yet been incorporated in Austin designs. But industry observers believe Austin will have to follow the continental lead eventually.

Canadians Veto US Truck Designs

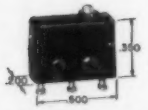
HAMILTON, ONT.—Trucks of US design are not rugged enough to operate efficiently under all road and climate conditions here. Hence, International Harvester of Canada is introducing a new line of heavy duty vehicles, according to IH Pres. Robert B. Bradley. Unitil now IH has sold trucks imported from the US.

In many parts of Canada, roads are well below US standards. Trucks that travel them need heavier front and rear axles, heavy-duty transmissions, and in some cases lower gear ratios and stronger cabs, Bradley says. The new line will have Rolls-Royce diesel engines.

Fewer Campus Hirers

WASHINGTON—For the first time in five years, there was a decrease in the number of organizations represented on the campus of the California Institute of Technology for purposes of interviewing students for future employment. From 183 in 1956-57, the number dropped to 158. Every CIT engineer graduate received and accepted an offer of employment. Starting salaries ranged from $575 to $1050 a month, with a median of $750.

MICRO SWITCH Precision Switches



ACTUAL SIZE

More news about the "SX" miniaturized subminiature switch

The new "SX"—smallest precision snap-action switch—offers a new kind of answer to switching problems involving space, weight, and reliability. Here are some of the reasons:

SIZE (of case): .500″ x .200″ x .350″ high—ten to the square inch.

WEIGHT: 1 gram . . . 28 switches to the ounce.

ELECTRICAL RATING: 28vdc: 7a. resistive, 4a. inductive-sea level; 2.5a inductive-50,000 ft.; 4a. motor load, 24a. max. inrush. 115/230 vac: 5a. resistive, 15a. max. inrush.

Other useful and newsworthy features of this remarkable switch include these:

Mechanical life is in the millions of operations.

The case of the "SX" has two through holes that will accept #2 screws. One hole is slightly elongated to facilitate mounting.

The "SX" operates dependably in temperatures from −65° F. to +250° F.

Operating force is controlled and predictable within 3 oz. to 5 oz. limits.

Terminals are integrally molded.

Special plating on terminals improves ease of soldering.

The normally-open and normally-closed terminal-contact inserts are solid silver and in one piece for maximum conductivity and heat dissipation.

For more information about this important switch, ask for Data Sheet 148.

New actuators add to versatility of "SX" Series

Two of the auxiliary actuators for the "SX" are shown below. Others, not shown, are pivoted lever and pivoted roller lever variations. All are made of stainless steel.

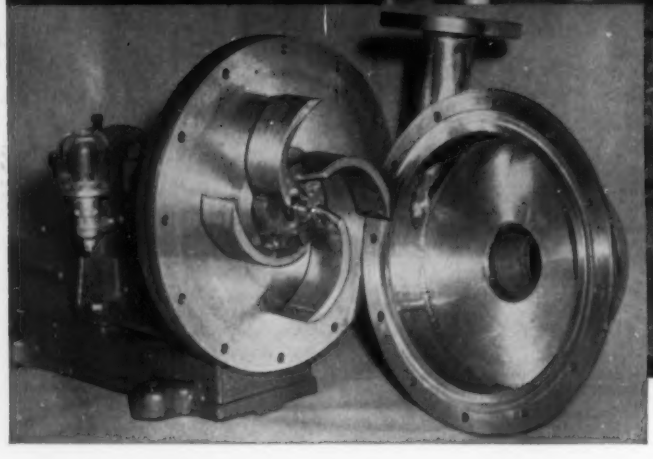
LEAF ACTUATOR

ROLLER LEAF ACTUATOR

MICRO SWITCH . . . FREEPORT, ILL.
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH PRECISION SWITCHES

Centrifugal pump fabricated economically and without difficulty from REPUBLIC TITANIUM



Mission Manufacturing Company, Houston, Texas, has added a worthy companion to its full line of centrifugal pumps for corrosive and abrasive applications. Shielded-arc welding techniques now permit the use of titanium in its maximum corrosion-resistant form for particularly severe pumping applications.

The pump shown above was fabricated by shaping, welding in an inert gas atmosphere, and machining. It is being used by a leading chemical company to handle ferric chloride at temperatures of about 212°F. The finished pump, incorporating the exclusive Mission Concentric Casing, contains 34 pounds of Republic Titanium.

Performance ratings are essentially similar to those obtained for cast iron or corrosion-resistant alloys. Fewer pump sizes are required because the flat characteristics of Mission's impeller design provide a wide operating range and sustained efficiencies.

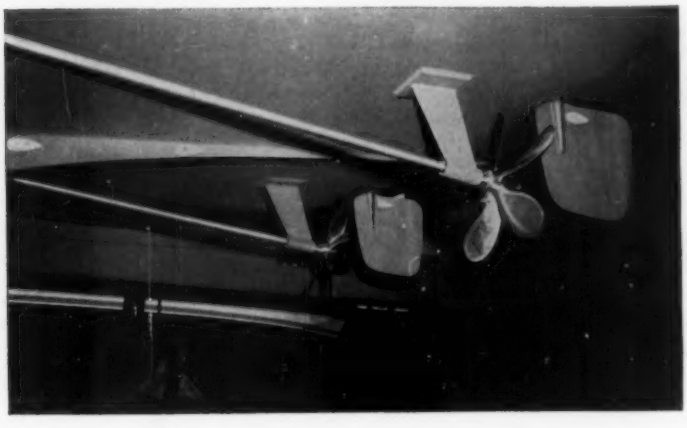
The entire fabricating operation was performed without difficulty and with little change in procedure as compared to other materials of construction.

Does this application of Republic Titanium spark an idea for your product that needs to be strong, lightweight, and corrosion-resistant? Republic Metallurgists and Machining Specialists will help you apply titanium's advantages now.

Republic produces commercially pure titanium and titanium alloys in ingots, billets, hot rolled and cold finished bars, plates, sheets, and strip. Mail the coupon for more information on these titanium forms, or for metallurgical and machining assistance.

SAVINGS IN MACHINING AND PRODUCTION COSTS of Ace Screw Extractors are obtained by the Henry L. Hanson Company with the help of Republic Cold Drawn Leaded Alloy Steels. Rolling of the extractor spirals formerly required several passes, each followed by an annealing operation. Now, with Republic Leaded Alloy, separate passes can be made deeper, reducing the total number of steps. And, because cold drawing improves the machinability of any given analysis, savings in machining costs are secured. Republic Alloys, Types 4140 and 4150, also provide a high degree of hardness and toughness. These properties in combination with scientific heat treating make the extractors practically unbreakable. Get all the facts on the advantages of Republic Cold Finished Alloy Steels. Mail the coupon today.

LOWER COSTS, IMPROVE QUALITY, INCREASE PRODUCTION with Republic Cold Drawn Special Sections. Because they are formed to the predominating cross-section of the part, Republic Special Sections eliminate or greatly reduce required machining. Results are faster output and lower cost. Also, since cold drawing improves the physical properties of any given analysis, completed parts are stronger and longer wearing. Other advantages may include improved appearance and simplified design. Send coupon for complete facts.



IMPROVED PRODUCT PERFORMANCE is reported by Roamer Steel Boats, Division of Chris-Craft Corporation, since switching to Republic Cold Finished Stainless Steel Bars. Vibration, a mechanical problem caused by out-of-true drive shafts, has been reduced to a minimum by Roamer through standardization of stainless shafts for their line of pleasure cruisers. The shafts are machined from uniformly straight Republic Cold Finished Stainless Steel Bars, Type 304. The bars meet Roamer's strict, maximum tolerance requirement of .006″ runout in 72″ of shafting. Stainless steel shafts also provide high strength and outstanding corrosion resistance. Republic specialists will help you use Cold Finished Stainless Steel Bars to best advantage. Mail coupon for more information.

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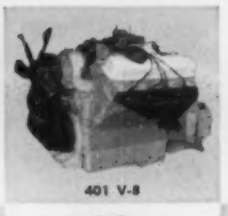
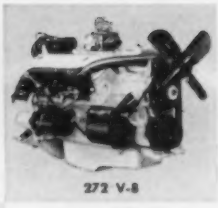
534 V-8

477 V-8


401 V-8

332 V-8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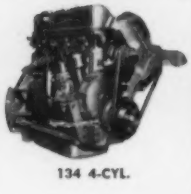
223 6-CYL.

172 4-CYL.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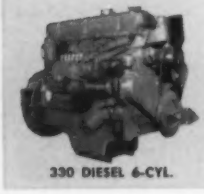
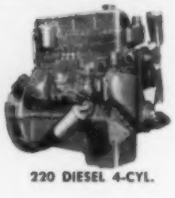

330 DIESEL 6-CYL.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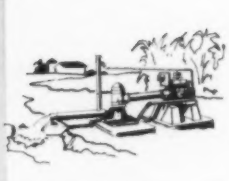
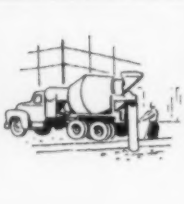
NOW...TEN FORD INDUSTRIAL ENGINES TO MEET YOUR POWER NEEDS!





Whatever your application, consider the many advantages you get with a Ford Industrial Engine.

Completely modern throughout, all Ford engines have Short Stroke design for increased operating economy . . . overhead-valve construction for quick, easy servicing . . . and provide more horsepower per pound of engine weight than ever before possible. To cut costs on *big* jobs, Ford offers 3 new Super Heavy Duty V-8's with totally new lubrication-, cooling-, and fuel-systems.

Ford Industrial Engines range from 134 to 534 cubic inches . . . including two Diesels. All are available as engine assemblies or power units, and can be fitted with Ford-approved attachments such as SAE housings, torque converters, transmissions and other equipment for special operating needs.

What's more, Ford users enjoy a minimum of downtime because there's always a Ford Dealer nearby with a complete stock of the more commonly purchased replacement parts. Yours at low Ford prices.

Get the *right* power for your application. Check Ford's full line of 4-, 6-, and V-8-cylinder engines soon.

INDUSTRIAL ENGINE DEPARTMENT • FORD Division of FORD MOTOR COMPANY
P. O. Box 598, Dearborn, Michigan

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED!

LESSON VI . . .

FIVE STEPS TO FASTER READING

By THE READING LABORATORY INC

How many of these techniques have become part of your reading habits?

PHRASE READING: Let your eyes fixate only three of four times on a line, taking in whole meaningful thought units each time they stop.

PHRASE CIRCLING: Circle phrases or meaningful thought units, until you become adept at the technique of phrase reading.

SPACE READING: Instead of focusing your eyes directly at the line of print, look in the space above it.

MUMBLING: Practice reading while you are chanting aloud in order to learn to read by vision alone, rather than by saying and hearing each word.

PRE-READING: Get a rapid, systematic over-view of every article and nonfiction book you read. Use this over-view in deciding what reading method you will use and in formulating questions before you read thoroughly.

SKIPPING AND SKIMMING: After pre-reading, decide what parts of an article may be skipped, and what parts may be glanced over quickly for facts and main ideas.

ENVIRONMENT: Read in a well lighted, quiet room.

ELIMINATE DISTRACTIONS: Try to take decisive action in order to clear your mind of nagging worries.

QUESTIONING AND ANTICIPATING: Ask questions after pre-reading and as you read thoroughly. Anticipate what the author is going to say. Both of these techniques will help you to concentrate.

VOCABULARY: Be on the lookout for new words. Try to deduce their meaning from the context in which you find them. Make a list of new words and try to use them in your speaking and writing.

WELL-ADJUSTED READING: Vary your reading speed and method according to the difficulty of your material and the purpose with which you are reading it.

CRITICAL READING: Distinguish between reports and judgments. Evaluate reports and judgments externally, on the basis of your own experience and knowledge, and internally as to the validity of the author's argument.

SUMMARIZING: Review, at least in your mind, the main idea of each paragraph as you read it; then summarize the article as a whole. This will help you to understand, as well as to retain, the main ideas of the article.

Do not be discouraged if these techniques have not yet become habits. But do continue to practice them until you no longer have to think about them.

At the beginning of this series, you measured your reading speed and comprehension. Now, to see how much you have improved in both areas, turn to page 23 and read the article on Soviet plastics which contains 1900 words, noting the time yon need to complete the article. Compute your reading rate in words per minute. Then answer the five questions below, counting twenty points for each correct answer. The answers are below.

Compare this reading speed and comprehension with your beginning scores. If you have learned and used these suggestions for better reading, you should have improved in both areas. Your reading skills will continue to improve as you convert all of these techniques into habits. Your reading load will become lighter and easier to handle, and better reading habits will pay off in terms of time-saving and personal satisfaction. ■

QUESTIONS

1 Name three products now being made of plastic in the USSR.

2 Where is Soviet plastics research ahead of us?

3 How long would it take for their plastic production to catch up with ours?

4 Do their engineers follow our technical lead?

5 Has the technical "cold war" been effective?

ANSWERS

1 Sleeve bearings, steering wheels, trays, electric panels, pipe, valves and fittings, pump impellers, toys, etc.

2 High-impact styrenes and fluorinated plastics applications.

3 With political pressure, as in the steel industry, in 10-12 years.

4 They often know more about the content of our technical magazines than we do.

5 Our refusal to sell them machines has hindered them, but they are catching up. We must forge ahead ourselves to stay in the lead.

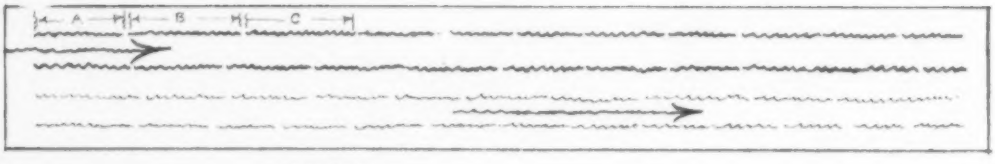
To receive a free reprint of this series write "Reading Lessons" on reader service card.
A more complete discussion of all aspects of reading improvement, plus practice exercises, is available in the book Cut Your Reading Time in Half, written by The Reading Laboratory and available for $1.25 from its publisher, Developmental Research Institute Inc, Dept E, 500 Fifth Ave, New York 36.

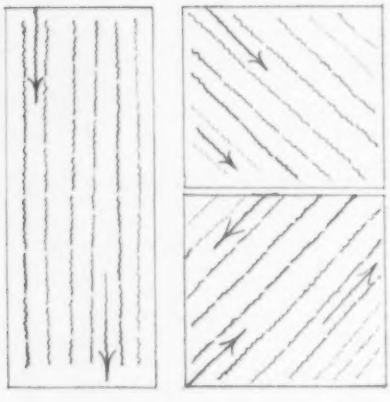
FREEHAND SKETCHES— HERE'S HOW

Clean straight lines, angles, circles and ovals can be drawn quickly, accurately and without erasures using this new technique. You can produce natural-looking perspective, cutaway and even exploded assembly drawings without instruments.

This technique eliminates long hours of sketching practice by making use of the natural muscular reactions of your hand and the natural sense of proportion which enables you to see the slightest deviation in straightness, angle or fairness of curve.

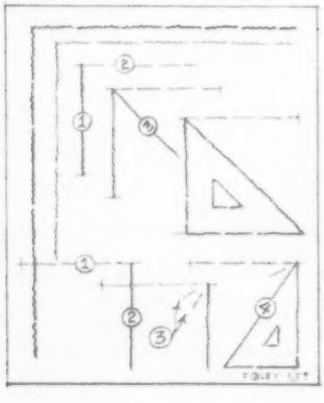
JEROME J FOLEY JR





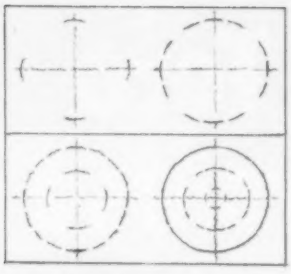
1 LINES

- Hold pencil exactly as you do to write but place paper straight up and down before you instead of at a writing angle.
- Draw a short wiggly line—slowly and deliberately. Make each closely spaced wave as even as possible. Exaggerate the wiggle at first.
- Look back at the line you are drawing instead of ahead of your pencil. You must concentrate to do this but this is the key to drawing straight lines freehand. It enables your sense of proportion constantly to correct the line as you draw.
- Do not slide your hand at first. Draw short segments leaving a slight break between each segment and moving your hand to a new position each time.



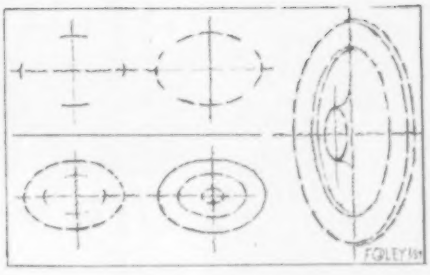
2 ANGLES

Now try some right angles. Start second line very slowly, looking at the angle at first, then at line behind pencil. Note how 45°, 30° and 60° angles are constructed.



3 CIRCLES

Draw crossing right angles lightly and locate four points carefully. Then draw slowly, in short segments, away from each point, completing all quarters at once.



4 OVALS

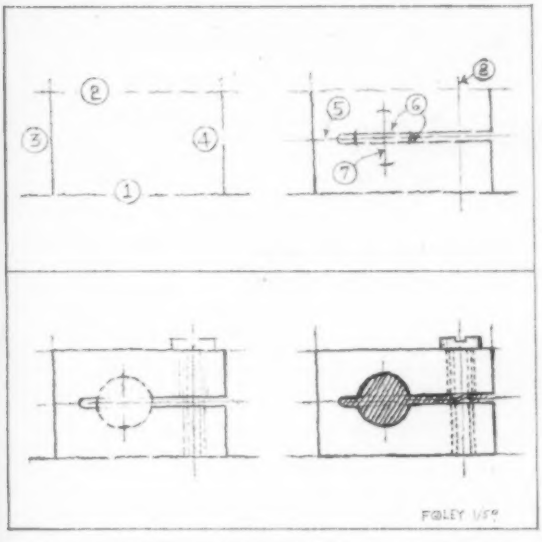
Construct exactly as circles except that lines from short axis line are drawn longer than those from long axis line. The difference in segments is proportional to the oval dimensions.

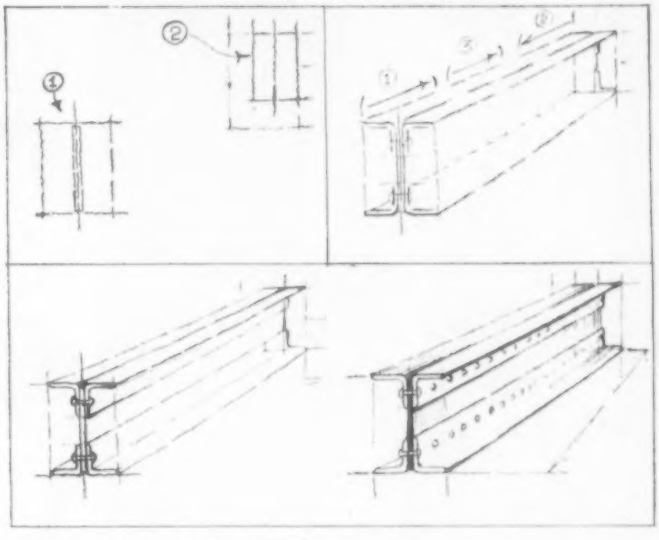
5 SIMPLE CLAMP

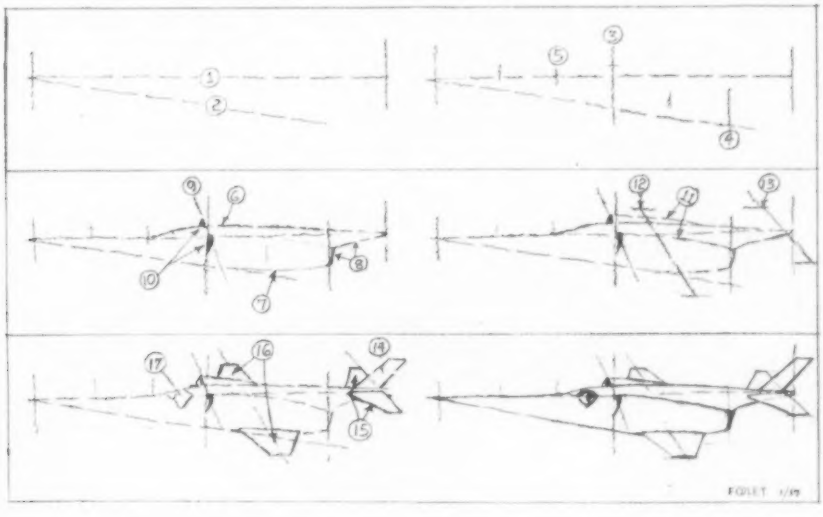
Proceed as shown. Use hard pencil or draw very lightly and deliberately. Calculate dimensions before each line is drawn. Darken wanted lines with a soft pencil to finish. Use construction lines for dimensioning.

6 TRUE PERSPECTIVE

Actual vanishing points are eliminated by sketching farthest end of an object in a selected reduced size as shown. The fast wiggly lines are also an attractive shading technique for metal, plastic and glass. Note the perspective treatment of the dimension lines to add realism.







7 MORE COMPLEX SUBJECTS

Three-dimensional objects like this "Stilletto" can be easily developed by adding this technique to standard drafting practice.

REMEMBER—

Look back, draw deliberately in slightly wiggly lines.

New 1959 Toro mowers use . .

1 MARLEX Engine Canopy

- **Does not conduct heat**—prevents burns.
- **Will not discolor** from gas, oil or heat.
- **Resists shock**—protects engine from damage.
- **Rigid**—keeps out branches when trimming, leaves cooling system open.

2 MARLEX Discharge Deflector

- **No sharp edges** to cut or scrape operator.
- **Lightweight**—machine is balanced for easy handling.
- **Takes a punch!** MARLEX deflector helps aim discharged material safely down away from operator.

3 MARLEX Discharge chute for bagging attachment

- **Absorbs shock** of vacuumed-up material being blown out of machine.
- **Unbreakable**—MARLEX can take all sorts of punishment. Won't crack, rust or corrode.
- **Wears and wears**—resists abrasion from discharged material.

MARLEX COMPONENTS MOLDED BY FLAMBEAU PLASTICS CORP., BARABOO, WISCONSIN

...MARLEX*

... for lightweight, durable, abrasion-resistant parts

These new Toro rotary mowers incorporate three MARLEX linear polyethylene components in their ultra-modern design ... the engine canopy, discharge deflector and discharge chute.

During the selection of a material for these parts, many plastics were tried, but MARLEX was the only resin that successfully withstood the severe shock-loading and abrasion tests!

Toro truly set the pace in 1959 power mower design when they chose MARLEX, the versatile new heavy-duty rigid polyethylene.

No other material serves so well and so economically in so many different applications.

How can MARLEX serve you?

* MARLEX is a trademark for Phillips family of olefin polymers.

* * * *

The new Toro Whirlwind Mower's styling was directed by Charles Butler, president of Charles Butler Associates, New York. This design firm also has a designer working full time with engineers at the Toro Research & Development Center in Minneapolis. Three years of research and experimentation went into the engineering of the housing alone!

When the designs of the MARLEX components were approved, Toro called in Flambeau Plastics Corp., of Baraboo, Wisconsin to engineer the mold design and mold the parts. Flambeau, working with Phillips Sales Service Laboratory engineers, designed special multiple-gated hot-runner molds to handle the injection molding of these unusually complex pieces.

PHILLIPS CHEMICAL COMPANY, Bartlesville, Okla.

A subsidiary of Phillips Petroleum Company

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CIRCLE 65 READER SERVICE CARD

POINTS OF

THE QUESTION: ***What Major Technological Advances Do You Foresee in Your Industry During the Next Five Years?***

DR E W ENGSTROM
Senior Executive Vice-president
Radio Corporation of America

"The electronics industry . . .

is in a period of rapid transition from earlier techniques toward new methods placed at its disposal by basic research. The trend is one with broad effects upon virtually all electronic products and processes.

"Electronic techniques of energy conversion are leading to new auxiliary power sources for many applications. Solar cells already are producing useful power from sunlight. Progress is being made in the development of thermionic and thermoelectric generators, to transform heat directly to useful amounts of electricity. Looking to the more distant future, electronics is playing a major role in research seeking to control thermonuclear fusion, which may one day provide a limitless source of power.

"We have embarked, within the past decade, upon the ever wider application of new electronically active materials, giving us the ability to obtain ever greater precision and economy in the achievement of both familiar and new electronic effects. This is leading to extreme economy of power and space in all electronic equipment, together with greater sophistication in functions that can be performed. As a result, electronic techniques are becoming applicable in many areas from which they were previously barred because of size, complexity and cost. Advances are even now being made toward the achievement, within an integral piece of material, of multiple effects which now require complex equipment or a combination of devices.

"From progress in these two specific areas—power generation and vastly improved electronic techniques—will come a wealth of new or better electronic products and processes. These will be applied to advance our missile and satellite technology, to further the development of automation in business and industry, and to generate a wide variety of new appliances and services for the consumer."

DR J B AUSTIN
Administrative Vice-president—
Research and Technology
US Steel Corp

"In US Steel's operations . . .

the technological advances we foresee are centered largely on gaining increased output from existing equipment. In the blast furnaces, this will be accomplished by better preparation of the blast-furnace burden through the use of beneficiated ores, the sintering of these ores, and better-quality coke. In the steelmaking furnaces, increased use of oxygen will raise the output rate. Better control of rolling and other mechanical operations by automatic devices is expected to increase production.

"Further technological advances in the next five years will see our operations produce improved steels, particularly with respect to higher strength at room temperature and at the high service temperatures met by space vehicles and manned aircraft. Finally, technological advances will lead to a whole new family of coated steels which will be used for containers, furniture, construction, appliances, automobiles, etc."

VIEW

"The machine-tool industry . . .

has always been alert to the end products of research and technological improvement. What lies in the future? There are many developments ahead that might radically change production techniques. While it is true that electronically controlled machines are on some production lines, this phase of the industry is still in its infancy. The machine-tool industry readily responds to advances in electronic and electrical developments and is quick to apply them to improvement of productivity. Likewise, ceramic tools are in the early stages of development, and may call for new designs just as the advent of cemented-carbide tools did in the immediate past. The use of ultrasonic waves for many mechanical processes is also in its infancy. At the moment, no one can prophesy the outcome.

"Those of us in the industry realize that machine tools are still the master tools of industry. It is highly competitive but a dynamic and progressive industry, and the American machine-tool builder intends to continue to build the best machine tools in the world."

ALFRED V BODINE
President, The Bodine Corp
Past President of the National
Machine Tool Builders' Assn

"The motoring public will benefit . . .

from the greatest technological advances in the history of our industry if the trend established in the last 50 years of automotive design continues for the next five years. As long as engineers, designers and technicians are dissatisfied with the performance of any of the automative components used today, improvements will continue to be made.

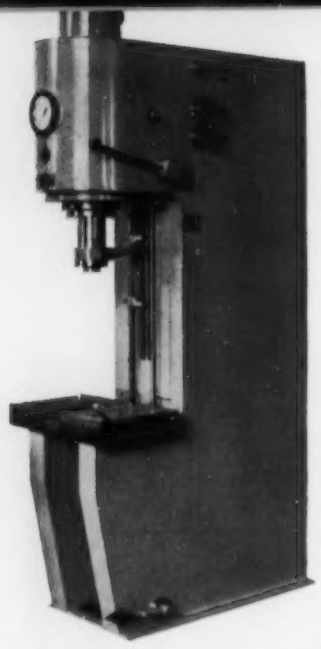
"To determine the technical advances which will be made in the next five years, therefore, only requires that we look at a list of the areas which require improvement or consideration:

1. More economical operation of automobiles. This involves the design of many individual components as well as an over-all reduction in the vehicles' weight, and this economy must be produced while the high performance required for passing or climbing grades is not sacrificed. This area also covers incomplete and inefficient combustion of fuel materials under various load conditions.
2. Better performance and reliability of brakes.
3. Reduction of the noise level of present automobiles. The single-unit body construction has been a major advancement in the area, but additional improvements are required.
4. Safer automobiles. Certainly the yearly traffic-death statistics exert a sobering influence on all automotive engineers, and many advancements are dictated in this area.
5. More effective sheet-metal corrosion resistance. Rambler's "deep dip" paint primer bath process is an important milestone, and refinements will be made.
6. Improved durability of automotive components.
7. Does today's car fulfill or exceed our needs?

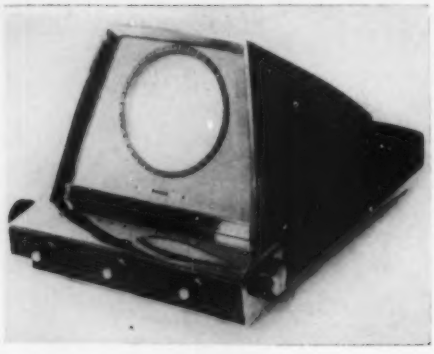
This area is under intense scrutiny, especially in view of the recent success of the small and compact cars in America."

R H ISBRANDT
Director of Automotive Engineering
American Motors Corp

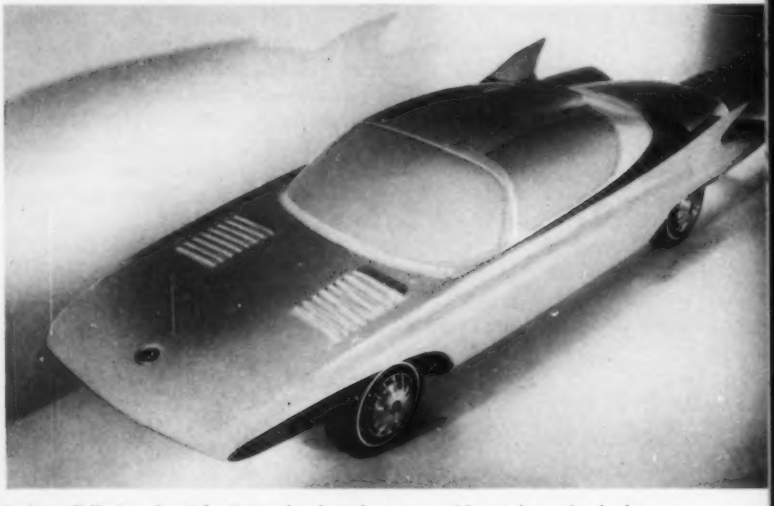
TRENDS in



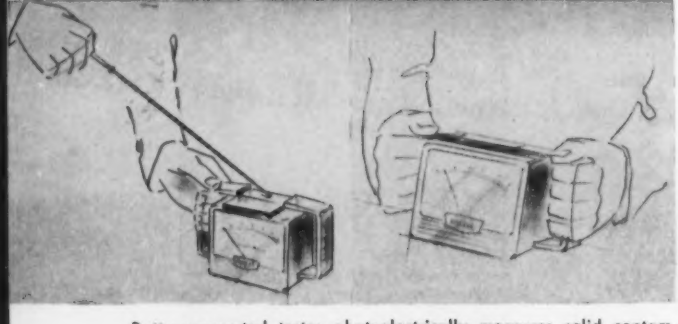
Design and location of controls, greater accessibility of tables, tools and hydraulic system, closed construction and cutaway base (for operator comfort) characterize redesigned press from Jenny Pressen AG, Switzerland.



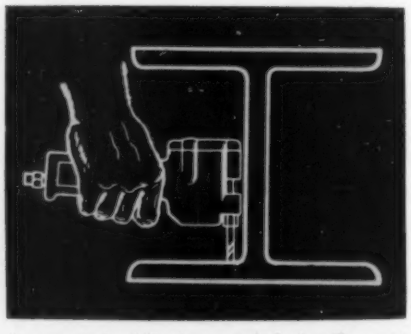
Small-boat radar displays, on either 1- or 5-mile scales, positions of other vessels and objects. Inclined face lessens over-all height and provides convenient viewing angle. By Sundberg-Ferar Inc, Royal Oak, Mich, for Sperry Piedmont Co.



DeSoto Cella I is the "idea" car developed as a possible package for hydrogen-oxygen fuel cell engine reportedly under development by Chrysler. Direct conversion of chemical reaction to electrical power would be used to operate electric motor-driven wheels, which would have regenerative braking. Roof would lift for easier access, instrument panel would telescope on impact, all but driver's seat would face rearwards, and fins will still be with us.



Battery-operated tester photoelectrically measures solid contaminants in engine oil when drop is placed in cell under hinged cover. Developed in service-station use tests, device has two handles—making it possible to pick up, insert oil sample, display reading with either hand. Made of high-impact acrylontrile. By Peter Schladermundt Associates, New York, and Farrington Mfg Co for Socony Mobil Oil Co Inc.



Air-operated drill has angled handle and squeeze-type switch positioned for natural hand position. Operates within 9/32-in. radius in 90° corners. Winslow Product Engineering Corp, Arcadia, Calif.

appearance design...

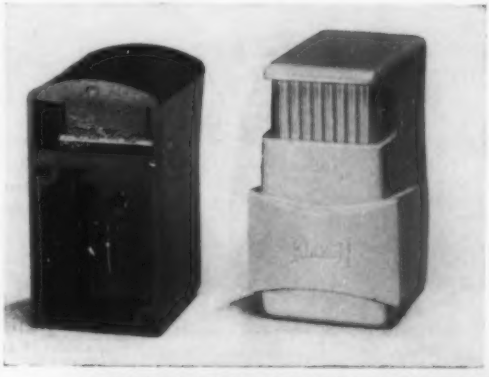
SMALL ELECTRICAL COMPONENTS

With one exception, samples of the products redesigned for Spencer Thermostat Div, Metals & Controls Corp, by Paul Wrablica Assoc, New York, could be held on one outstretched hand—all at the same time, and including those not shown here! All are electrical and electronic components.

On such minute design subjects, redesign for appearance without affecting engineering considerations would be difficult —and probably meaningless. So the Wrablica staff was allowed to suggest new approaches to circuitry, materials, production methods and costs, installation procedures. Any such basic changes were worked out in collaboration with the Spencer engineering staff.

A

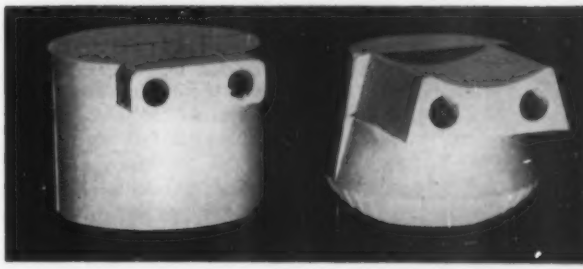
Asked to devise a carrying case for a thermostat tester (A), the Wrablica staff designed housing that eliminates need for it. Originally, housing was an expensive, deep-drawn stainless steel shell. New housing is cast aluminum, with an easy-to-stamp stainless wrap-around. Handle is integral and hole in upright provides storage for glass thermometer customarily used with this device. Although same internal components had to be retained, all wiring now comes out same side. Curve in top of bracket-shaped housing permits lower handle height while still providing adequate gripping space—curve also frequently permits use of less-than-perfect castings.



B

When service men would remove former Spencer motor protector-relay, (B) lack of an adequate gripping surface caused them to twist as well as pull. This generally distorted the unit's three prongs. New design reduced housing parts from 3 to 2 (now there is only one ribbed snap-on panel) and used bow-shaped trademark to provide grip. Although wire terminal area is reduced, terminals (not shown) are more accessible, because now they face frontwards.

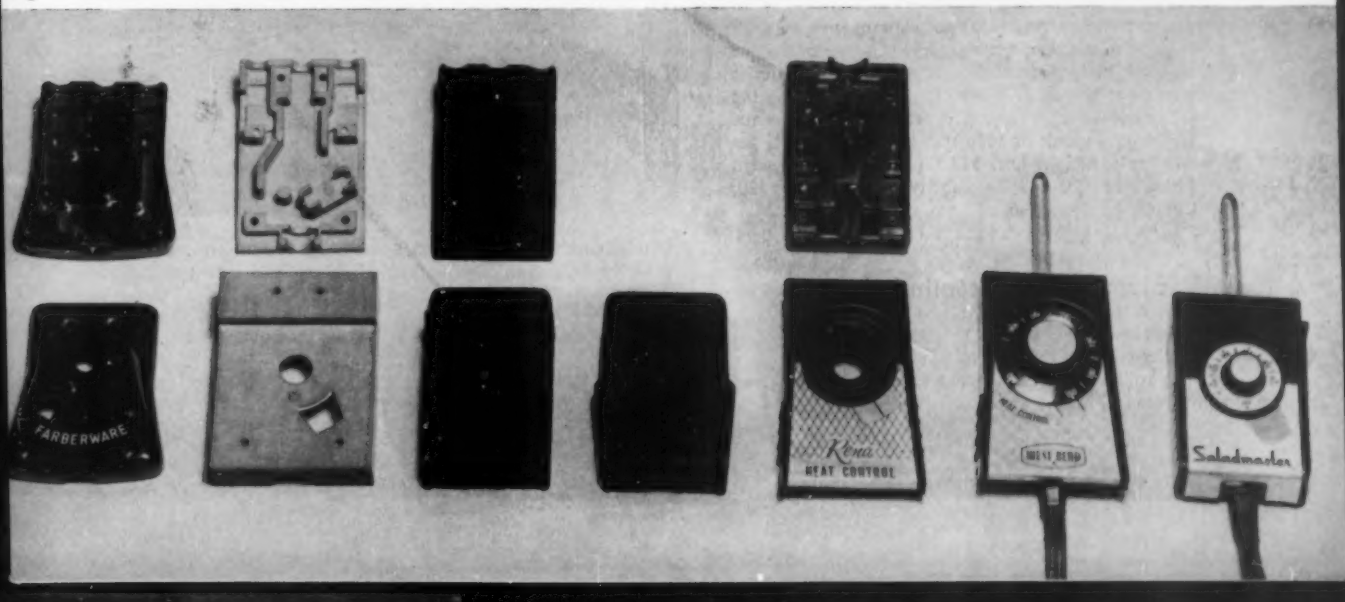
Rubber boot (c) for air-conditioner thermostat gained a look of identifying distinction and lost ugly flash caused by parting line—yet molding process is the same.



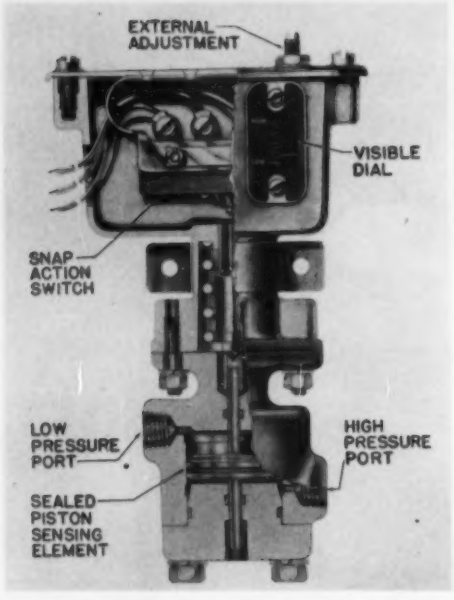
C

When patents on electrical plug (D, at left, below), for such appliances as frypans, were expiring it was decided to redesign device so that it could be sold to other manufacturers. Plastic prototype and wooden shape studies indicate development of two basic parts—same base (or wiring) and two different cover plates—capable of various decorative treatments. ■

D



SIGNIFICANT COMPONENTS MATERIALS PROCESSES



Pressure switch . . .
senses a difference of 5 to 140 psi between two pressures. Sealed-piston sensing element actuates an electric circuit upon increasing or decreasing of predetermined difference. Applicable to oil systems ranging from 50 to 6000-psi working pressure. Field setting is accomplished by external adjustment screw and dial. Sensitivity is from 5 to 15 psi, depending on range of system. List price, $33. Delivery, 2 to 3 wk. **Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58.**

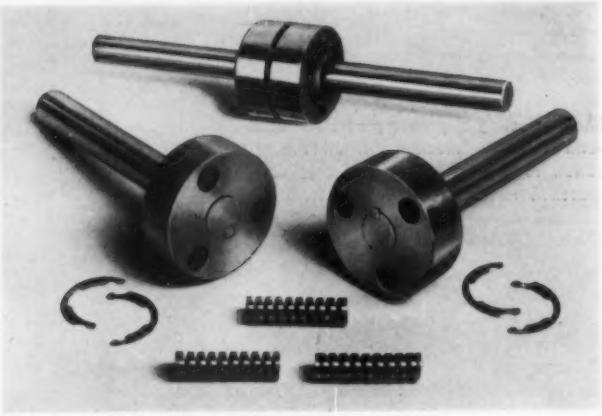
Circle 11, Reader Service Card

Precision counter uses planetary . . .
gear drive to rotate numerals, instead of usual Geneva movement. Nylon cam and roller compensating device moves planetary gear. Said to allow no possibility of skips or misses since gears are always in mesh. Torque required to turn drum is uniformly low; any device capable of turning first drum is capable of driving the entire counter reliably, as there are no peak load points. Continuous speeds of 1000 rpm (or 10,000 counts per min are possible). List, $27.50; from stock. **Haydon Instrument Co, 165 W Liberty St, Waterbury 20, Conn.**

Circle 12, Reader Service Card

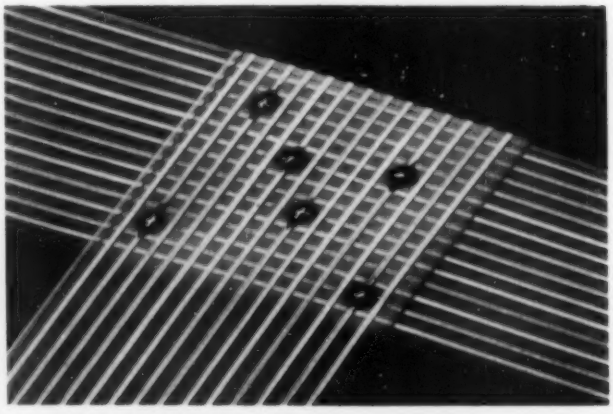
Vacuum cadmium coating . . .
a low-cost method for protection of high-tensile steels against corrosion, is said to eliminate hydrogen embrittlement. Coatings up to 0.001 in. thick and more are possible. **NRC Equipment Corp, 160 Charlemont St, Newton, Mass.**

Circle 13, Reader Service Card



Self-aligning free coupling . . .
consists of identical halves, joined only by helical wire springs, which transmit all thrust. Springs are held in place only by snap or split rings. Coupling operates in either direction of rotation and can be installed either horizontally or vertically. Said to be shock-absorbing and to permit max misalignment, because it transmits torque without end thrust, even under load. Load factor is 7:1. Units are rated to 5600 hp at 100 rpm. Available in any size, but standardized in four series: light (shaft size up to 2-in. dia); medium (2 to 5-in. dia); heavy (5 to 12-in. dia); mill motor (2½ to 4-in. dia). Now available in steel, but can be made in other materials. **Atomatic Mfg Co, E Pittsburgh, Penna.** Said to be 5 to 10% cheaper than gear-type couplings in small quantities; greater savings on production lots. 2 to 3 wk delivery.

Circle 14, Reader Service Card



Multiconductor tape is soldered through . . .
polyester insulation. This is done by laying one section of tape on another, punching at desired intersections, and then soldering together. For production, templets are usually prepared. Tapes containing as many as 50 conductors and up to 1000 ft length may be obtained. Conductors are 0.015 x 0.030 in., spaced 0.100 in. on centers. Electrical rating: 1 amp, 300 v ac. **Tape Cable Corp, 790 Linden Ave, Rochester 10, NY.**

Circle 15, Reader Service Card

Want fast, economical solutions to your heating problems?

Call your Chromalox Man for the Answers

Your Chromalox Representative—the man with the answers to your heating problems, routine or unusual—has over 15,000 standard types, sizes and ratings to choose from. Many of these are stocked in quantity for immediate shipment. Moreover, Chromalox has the design and manufacturing facilities to promptly build special elements to fit your special requirements, plus a complete range of controls and accessories. For instance . . .

- Strip heaters in lengths to 96 inches, wattages to 1500, temperatures to 1200°F. Heater bands for injection and extrusion barrels.
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- Chromalox Electric Cartridge Heaters give more dependable spot heat with close thermal control. Exclusive design gives positive lead wire protection against flexing, abrasion, moisture.
- New Microfin® units for space heaters and process air in ovens and ducts provide safe, fast heating. Limitless configurations provide maximum wattage in a given space.
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Volco Company
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Phone: 6-5233

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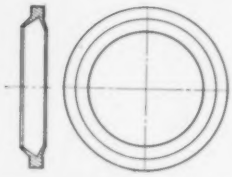
SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .



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Circle 16, Reader Service Card

Solid-state control device . . .

provides necessary signal to control thyratron systems which, in turn, can drive inductive loads as well as resistive loads with complicated circuitry. Can be used in circuits for static switching, temperature control, automatic welding control, variable d-c supply, constant current supply, pulse-width modulation. **Control Div, Magnetics Inc, Butler, Penna.**

Circle 17, Reader Service Card

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Circle 18, Reader Service Card

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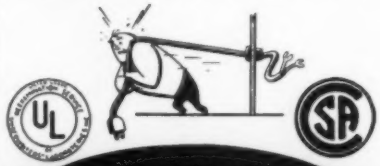

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competitive. **Narda Hydraulics Corp, Sub Narda Microwave Corp, 122 Herricks Road, Mineola, NY.**

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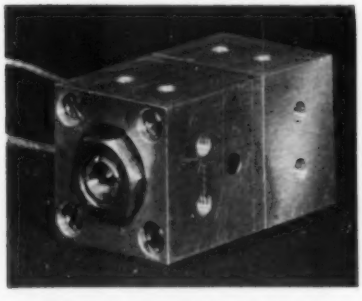
combines independent 28-v lamp circuit with momentary snap-action or push-on, push-off snap-action switch. Contacts rated at 28 v dc, 5 amp inductive. Length, from mounting surface to and including terminals, is 1⅜ in. **Pendar Inc, PO Box 3355, Dept G, Van Nuys, Calif.**

Circle 20, Reader Service Card

One-part allophonate . . .
is a prepolymerized coating said to provide excellent adhesion to a wide variety of surfaces. Can be sprayed, brushed, dipped. Available in both clear and colorless as well as pigmented in a variety of colors and can be procured in various degrees of gloss. **Howley Chemical Co Inc, 250 W 57th St, New York.**

Circle 21, Reader Service Card



Acceleration switch . . .
is continuously adjustable for sensitivity to positive and negative acceleration along a single axis. Contains a seismic mass driving an element with two stable positions. Adjusting screws bias element to provide variable sensitivity. In standard model, sensitivity is adjustable ±30 g. Acceleration being sensed triggers complete switching operation. Weight 5 oz. Delivery, 6-8 wk. **Eastern Technical Associates Inc, 31 Sudbury Rd, Concord, Mass.**

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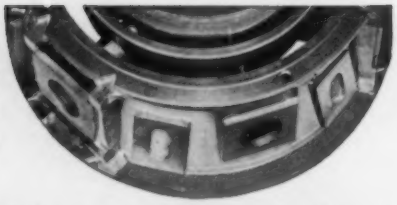
56 details of stainless steel jet engine component brazed in three steps with no distortion or oxidation by Wall Colmonoy . . .



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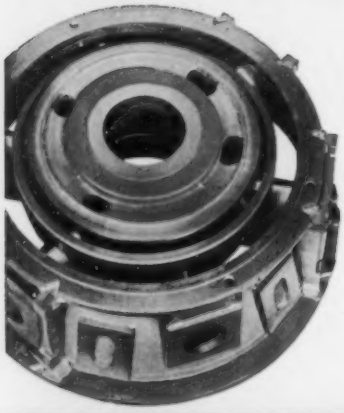

This jet engine diffuser casing is typical of the aircraft and missile parts being furnace brazed at Wall Colmonoy. As originators of Nicrobraz Process brazing, we have an unmatched background in the nickel-alloy brazing of stainless steel and superalloys. Our facilities also include vacuum furnaces for degassing and brazing titanium bearing alloys. Our three plants are ready and able to engineer and process your components. Call or write today.

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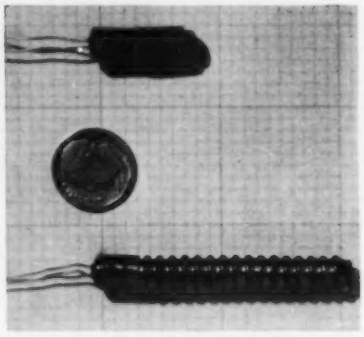

Squib-actuated bellows . . .
motor will also work around 90° curve, which provides positive displacement for the performance of mechanical work. Of special interest to designers of missiles, weapons and weapons systems. Measures 0.320 x 1 in. long. Actuated by as little as 100 ergs at 1.5 v or 0.3 amp, motor provides 10-lb thrust over a 1-in.-min stroke within 1 millisec. **Atlas Powder Co, Wilmington 99, Del.**

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can be operated in 329-F ambient. Available in 50 to 400 v ratings and will carry full 20-amp load in half-wave circuits and up to 60 amp in bridge circuits. **Fansteel Metallurgical Corp, Dept PEN, N Chicago, Ill.**

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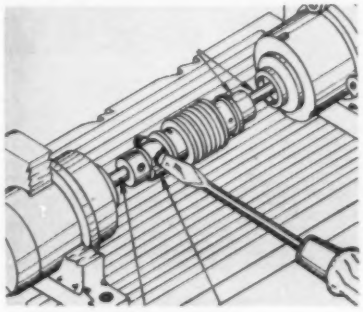

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permits rotational adjustment between two synchrorotors or other mechanisms requiring angular displacement. Eliminates rotating a synchro in its mounting to "zero-in" with its companion synchro. One turn (with screwdriver) of adjusting screw rotates one coupled shaft in respect to the other through only 12°. Measures 1.862 x 5 3/4 in. dia. **PIC Design Corp, 477 Atlantic Ave, E Rockaway, NY.**

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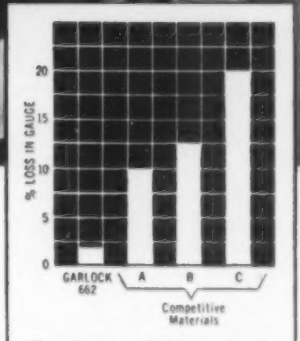

Chart shows loss of thickness after alternating wet and dry exposure tests. Garlock 662 returns to within 1% of original thickness. You can make these tests yourself. You'll prove that No. 662, made from a cork paper base impregnated with a synthetic rubber, is dimensionally more stable than competitive products.

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NEW LITERATURE

A History of Technology in Five Volumes

Edited by Singer, Holmyard, Hall and Williams. Published by Oxford University Press, Amen House, London. 10 x 7½, 888 pp. About $23.50 per vol.

A treatise covering the historical and technological aspects of science has long been sought. Many have tried; but the task of telling the story of man's conquest of environment and his development of machines has proved impossible in one or two volumes. Now, in five volumes, Singer et al succeed in tracing technological history from Stone Age dwellers to developments of the early 1900s.

Unlike many contemporary histories which deal strictly with the evolution of a specific field of technology, this history attempts to encompass all forms of technical advance including communication, food preservation, transportation, electrical utilization, textiles, aeronautics and machine tools. The admirable undertaking is accomplished by having a specialist write each individual chapter. Although this enables authorities to handle each specific subject, it unfortunately hampers the feeling of continuity that should be maintained in a chronological work.

Nonetheless, the facts are presented with ample illustrative drawings, in such a way that any historical library would be incomplete without all volumes. Unfortunately there are three indexes in each volume, on subject, place and name, rather than one overall separate index or one included in the final volume.

A sixth volume devoted to 20th century scientific achievements would be difficult and will have to wait until the story can be told objectively and in its entirety. The editors have wisely chosen to terminate their work before atomic energy fully opened the new era in science. —BAL

Engineering and Industrial Design

A one-day conference sponsored by British Council of Industrial Design (28 Haymarket, London SW 1, England) and Birmingham Exchange and Engineering Center late in 1958 heard a number of papers on the theme, "Industrial Design and the Engineering Industries." Two of the speakers discussed the role and contributions of the industrial designer, his working relationships with engineering personnel: "Engineer and the Industrial Designer," Dr E W Seward, of W & T Avery Ltd; "Role of the Industrial Designer," Misha Black. Application of industrial design to power presses was described by Louis Schuler, L Schuler AG (W Germany).

METAL FABRICATION—Booklet, 8 pp. Presents facilities for manufacture of sheet and plate of all gages, including housing, machine bases, containers. Smithcraft Fabrication Div, A L Smith Co, 200 Bent St, Cambridge, Mass.

Circle 1, Reader Service Card

NICKEL PLATING—Brochure, 24 pp. Answers 40 practical questions about process in a nontechnical way. Subjects include physical and chemical properties of coating, machining, welding and forming possibilities. Plating techniques and design factors are also discussed. Illustrated with design diagrams, curves and examples of applications. International Nickel Co Inc, 67 Wall St, New York 5.

Circle 2, Reader Service Card

FORGING FACILITIES—Brochure, 24 pp. Covers all phases of forging facilities and range of products. Lists characteristics and applications of custom die forgings. One section discusses forging problems and solutions. Park Drop Forge Co, E 79th St and Buck Ave, Cleveland 3.

Circle 3, Reader Service Card

DESIGNING GRAY IRON CASTINGS—News leaflet, 4 pp. A designer's digest, published to aid in specification and design of gray iron castings. Scheduled for bimonthly distribution, house organ will carry illustrations and descriptions of castings that have been redesigned from competitive materials at savings to the ultimate consumer. Available from gray iron suppliers or Gray Iron Founders' Society, National City–E 6th Bldg, Cleveland.

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PRINCIPLES AND PRACTICES OF RESISTANCE WELDING – Bulletin Federal PP-54, 24 pp. Illustrates and describes resistance welding in all phases. Includes resistance welding formula, data on how to calculate welding pressures. Federal Machine and Welder Co, Warren, Ohio.

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Publisher's Postscript...

THE PULSEBEAT—

Just about 18 months ago, after much study and research of the engineer's need for information, we decided to publish *Product Engineering* every week. It took some time to get all our ideas into print but right from the start hundreds of readers told us how much better they liked our publication as a weekly. Very few did not like the change.

Now time has passed. The staff is integrated—clicking—enthusiastic. From every standpoint the publication is moving forward—in editorial achievements—in steadily increasing number of readers—in recognition by manufacturers whose products you specify. Our plan of keeping our engineer-readers better informed has gained enthusiastic acceptance among design engineers in all walks of the profession.

We publish *Product Engineering*—not for an industry or a function, as most publications do—but rather for the engineer as an individual. We try to keep you well informed on the many areas of your broad interests. That's why occasionally we offer, through this column, special reports concerning the national economy that we feel forward-looking engineers should see—reports that obviously could not be included in the editorial content. You'll remember *Business Plans* and *The National Economy* that were made available to you last year. Over 3,600 readers requested them.

Now we have another interesting, meaty report that contains much information an alert engineer should have. It's an attractive 36-page booklet, printed in color, illustrated with 63 tables and graphs—a realistic look at 1959 through the eyes of McGraw-Hill's economic staff. It presents data on more than 40 major American industries—where they stand after the recent recession—where they are headed in 1959.

Based on current business and economic trends, this 36-page report surveys each industry served by McGraw-Hill's 39 specialized business publications, as well as other important industrial and commercial fields. The report was compiled by Douglas Greenwald of the McGraw-Hill Department of Economics, drawing on our round-the-world news gathering facilities staffed by more than 600 full-time editors, reporters and economists.

We call it the PULSEBEAT of Industry. It was prepared for the management men who must make the decisions throughout American industry, but we believe many engineers will also find it helpful.

We were able to get hold of only 1,800 copies. If you'd like one—just write PULSEBEAT on the reader service card on the facing page on the line marked "SPECIAL DATA," print your name and address and mail. It will go forward to you promptly, as long as the 1,800 last. —AH

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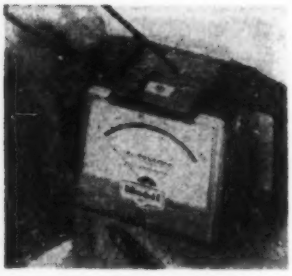

Change your oil, sir?

"Safe" or "Change" says the dial of this portable oil-condition tester developed by Socony Mobil engineers. And in between both black instruction bands is a narrow gray one that means "doubtful." Designed for one specific job, with low cost and simplicity as primary aims, Fotoscope uses a photocell to measure the solid contaminants in a drop of oil taken from a car's dipstick, bases its measurement on light transmission. Now going into production, it will make its debut at gas stations this spring.

Shows you the way to go home

An illuminator that "assures homeowners of positive house identification day and night, with no switches and no need to change bulbs" is being marketed by Terrace Electronics, Verona, NJ, as a display unit for house numbers and letters. Key to its claims: a cold gas diode said to provide illumination for less than 5¢ a month. Furthermore, Rohm & Haas Co proudly notes that using R&H Plexiglas acrylic plastic for case and numerals makes the unit weatherproof, allowing the supplier to provide a 5-yr. guarantee. Unit is 9 by 3¾ by 1¼ in., retail price is listed as $6.95 to $9.45, depending on selection of numerals or letters.

Finger-saver

Inquisitive fingers won't get caught in this garage door—and your hands won't, either—says Republic Steel Corp. It's a new design, deep-groove panels that are said to "physically reject your hand in closing." Full-width hinges hold the panels in alignment, and a tapered track with adjustable nylon rollers provides easy closing. A leveling bracket adjustment compensates for variance in floor level; and 2-position automatic latches permit the door to lock automatically on both sides. The complete unit is made by Steel Door Corp, 2400 Lincoln Road, Birmingham, Mich, using electrogalvanized, bonderized, factory-painted panels—Republic's Electro Paintlok, of course.

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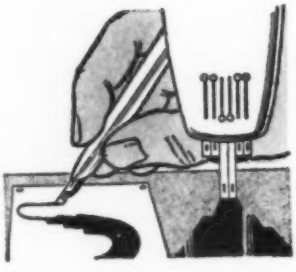

. . . a variable line-width ball point or nib pen. It would be especially valuable for accountants, secretaries, artists and draftsmen who must write or draw in many line weights. The general public would probably gobble it up, too. —R LONCTO

. . . an automatic program selector for home TV. It would permit preselection of all programs in advance—say for a week. The device would switch on and off from channel to channel at the selected times. Favorite programs will not be missed and mother could preselect for the children. —B W HAUSMAN

. . . an automatic stamp dispenser at supermarket cash registers. Counting out "green" stamps is inefficient and irritating. The device should be built into or attachable to the standard register and work automatically with the register totalizer. It would cut off the correct number of stamps untouched or thought about by the clerk. —J K WALLINGER

. . . a grease precipitator or attractor for ovens? As it boils off a roast, the fat vapor might be attracted to an electrostatically charged probe where it would collect on a removable, disposable jacket. This system would substantially reduce the drudgery of cleaning oven, walls, hoods and exhaust ducts of home and restaurant equipment and avoid fire danger. —L A LASSMAN

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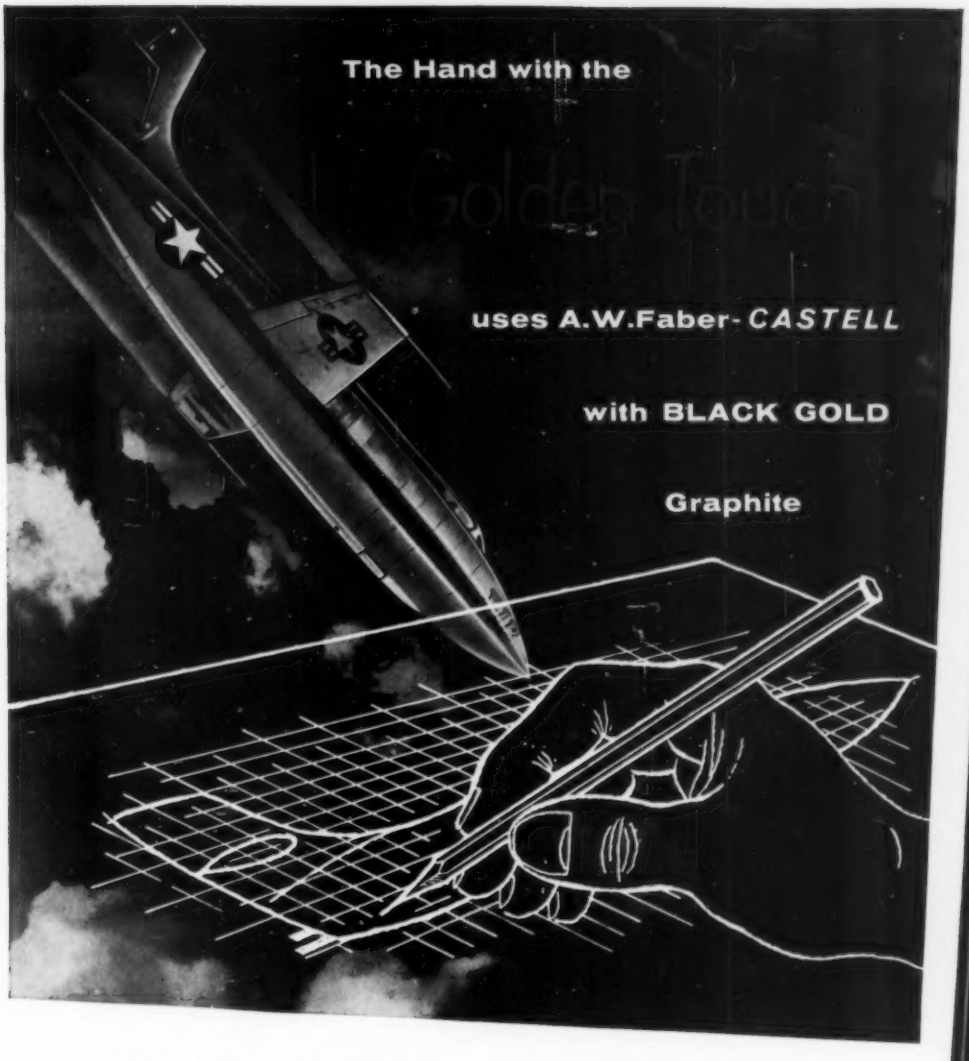

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